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COMPREHENSIVE STUDY OF SOLID WASTE DISPOSAL IN CASCADE COUNTY, MONTANA

Thomas, Dean and Hoskins, Incorporated
Great Falls, Montana

1970

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COMPREHENSIVE STUDY OF SOLID WASTE DISPOSAL IN CASCADE COUNTY, MONTANA

Final Report on a Solid Waste Demonstration

This publication (SW-6d) was prepared by
Thomas, Dean & Hoskins, Inc., Consulting Engineers
for the Board of County Commissioners of Cascade County, Montana
under a Demonstration Grant (No. 1-DO1-UI-00095-01)
from the Bureau of Solid Waste Management

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FOREWORD

An estimated 900 million pounds of wastes in the solid state are produced in the United States every day. What to do with these solid wastes, how to dispose of them without needlessly endangering public health and welfare, and how to recover and reuse valuable materials now "thrown away" are among the most challenging and perplexing of current national problems. Because of lack of suitable planning, interest, and public understanding, these problems have reached such proportions that nationwide attention is demanded and action for the development of adequate solutions must be taken.

Intensified action concerning these problems was made possible by the Solid Waste Disposal Act, Title II of Public Law 89-272, which was signed by the President on October 20, 1965. This legislation directs the Secretary of the Department of Health, Education, and Welfare to initiate, encourage, and support a national program aimed at discovering and evaluating better methods of coping with the solid waste problem.

The Secretary is authorized (1) to conduct and support research on the nature and scope of the problem, on methods of more safely and efficiently collecting and disposing of solid wastes, and on techniques for recovering from solid wastes potentially valuable materials and energy; (2) to provide training and financial and technical assistance to local and State agencies and other organizations in the planning, development, and conduct of solid waste management programs; (3) to encourage and support projects that may demonstrate new and improved methods of solid waste collection, handling, and disposal. The Bureau of Solid Waste Management carries out these responsibilities.

Among these responsibilities, the Bureau provides grant support for demonstrations relating to the development and application of new and improved methods of solid waste collection, storage, processing, and ultimate disposal; and grants for studies and investigations that may lead to a demonstration of improved disposal practices, or may provide solutions for regional or national solid waste disposal problems. Associated with this is the responsibility for collecting and making available by appropriate means the results of, and other information pertaining to, such federally supported demonstrations, studies and investigations.

This report was prepared by the Consulting Engineering firm of Thomas, Dean & Hoskins, Inc., for Cascade County, Montana. It is the result of studies and investigations carried out by the firm for the purpose of analyzing the county's existing solid waste management systems, and for developing comprehensive plans for storage, collection, and disposal of all solid wastes generated in Cascade County. Three alternative systems are outlined and the various aspects of implementation are discussed. The study was supported in part by demonstration grant DOl-UI-00095, made to the county by the Bureau of Solid Waste Management under provisions of Public Law 89-272, the Solid Waste Disposal Act.

This report is comprehensive, and thus it may serve as a good example of the general scope and specific details required to complete such a study of solid waste management. However, it is felt by reviewers in the Bureau of Solid Waste Management that Section VI - STANDARD METHODS OF REFUSE COLLECTION, is not complete. An addendum to the paragraphs, "Public Collection" and "Private Collection" follows this foreword.

-- RICHARD D. VAUGHAN, *Director*
Bureau of Solid Waste Management

ADDENDUM

To Section VI, page 61

Public Collection

Public collection is performed by public employees and equipment. Some advantages of public collection over the other three alternatives follow. Profits do not have to be earned in a public operation. Therefore, refuse collection can be less expensive by the amount of the profit. Citizens cooperate more readily with municipal operation than with privately controlled enterprises. Sanitation and health protection are main goals of collection systems operated by public entities. There are also disadvantages to public collection systems. Political interference with collection practices could demoralize collection personnel or result in unqualified supervisors being appointed. Many communities favor cheapness rather than economy in administration. Adequate retirement plans for employees are often not provided in public collection operation and salaries are relatively low.

Contract Collection Same as report as written except add to second paragraph on page 62 the following:

Collection equipment costs represent considerable investment and could not be justified for short term use, thereby requiring a reasonable length for a contract. Careful development of the contract document will protect the community and allow the contractor to provide the service desired.

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**Details of illustrations in
this document may be better
studied on microfiche**

SECTION I - SUMMARY AND CONCLUSIONS

In Cascade County unsightly open dumps, junk automobile hulks and other forms of rubbish litter the countryside. Conditions are getting worse. Efforts by the Great Falls City-County Beautification Committee, the Junior Chamber of Commerce and other civic minded groups have not produced the desired results.

This report considers the various forms of solid wastes and the related problems in their storage, collection and disposal. The text of this report discusses in detail the entire solid waste problem and methods to improve existing conditions.

To produce an effective and lasting solution, we recommend a county-wide refuse collection and disposal system to be operated by the City-County Health Department.

We recommend that Chapter 45 of Title 69 of the Revised Codes of Montana be amended to clarify the existing authority of the Board of Health to operate such a system and to charge for the service provided.

We recommend that the Montana Statutes be amended to prohibit the disposal of abandoned automobiles on private land and provide for licensing and regulating junk yards. A county-wide refuse disposal system would have the capabilities of disposing of junk automobiles at each of the landfill sites.

A concise summary of our conclusions follows:

1. Solid wastes have been shown conclusively to be associated with some diseases in the United States. Epidemiologic information supports the claim that solid waste bears a definite relationship to some diseases. Where

solid wastes are not disposed of properly, the morbidity and mortality rates from solid waste-borne diseases can be high.

2. Flies reproduce at an enormous rate in organic wastes. The fly population is largely regulated by the breeding opportunities afforded by solid wastes. Many human diseases found in this area can be transmitted by flies.

3. The rat also thrives in refuse and because of its habits and close association with man, it exposes man to various disease agents which are transferred by human contact, by ectoparasites of the rat, or by contamination of the human environment.

4. There are more than 5,000 abandoned cars and trucks located in Cascade County at unauthorized disposal sites. Another 5,000 junk automobiles are located in junk yards throughout the county. Over 500 old car hulks are placed along streams and rivers for use as riprap.

5. Due to the status of the commercial market for certain scrap metals and the freight rates to the processing centers, it is not economical to set up automobile processing equipment for preparing junk auto scrap for the steel processing plants.

6. The most satisfactory method of disposal of junk automobiles for Cascade County is to crush the hulks with heavy equipment and bury them. Donated labor or refuse collection crews could be used during slack periods to perform this work.

7. Residential storage should be standard 32-gallon galvanized containers fitted with fly-tight covers. Stakes or holders should be furnished for all containers. Lids should be chained to the rack or holders.

8. For collection, refuse containers should be located in the alleys or set out by the homeowner if there are no alleys.

9. Metal bulk storage containers of a type suitable for the dump mechanism on the collection vehicle should be required for all services needing more than four 32-gallon containers.

10. An organized collection system should serve the areas of concentrated population. From a health standpoint, it is less critical to have collection service in a sparsely populated area than in an area of concentrated population.

11. Excluding the area within the corporate limits of the City of Great Falls, Cascade County has been divided into 3 separate routing systems: (1) the eastern area which includes Belt, Neihart, Monarch, Tracy, Sand Coulee, Centerville and Stockett; (2) the western area which includes Ulm, Cascade, Simms, Fort Shaw, Sun River and Vaughn; and (3) the area surrounding Great Falls outside the city limits.

12. From a health standpoint twice per week collection has definite advantages over once per week collection, and is recommended for the Great Falls area. Because of the lower population densities and the travel distances involved, once per week collection is recommended for the rural routes.

13. On a once per week pickup basis, twelve 18-cubic yard collection vehicles are presently required in the Great Falls city limits. Twice per week pickup would require 20 collection vehicles of the same capacity. The Great Falls fringe area requires 1 collection vehicle. Two vehicles will be able to collect the rest of the county.

14. By 1988 the Great Falls metropolitan area will require 50 collection vehicles.

15. The U.S. Public Health Service has a demonstration grant program which provides for Federal grants for new and improved methods, practices, programs and techniques of solid waste storage, collection and disposal. Such a grant could help initiate a county-wide program.

16. The cost for initiation of the solid wastes disposal program, with once per week collection on the rural routes and twice per week collection in the Great Falls metropolitan area, is $941,949 per year. On this same basis the rate including the operation, maintenance and replacement costs is approximately $36.00 per residential dwelling per year.

17. The cost for initiation of the solid wastes disposal program, with once per week collection on the rural routes and also in the Great Falls metropolitan area, is $635,854 per year. On this same basis the rate including the operation, maintenance and replacement costs is approximately $24.00 per residential dwelling per year.

18. The cost for initiation of the solid wastes disposal program, excluding Great Falls within the city limits, based on a once per week pickup frequency, is $96,277 per year. On this same basis the rate including the operation, maintenance and replacement costs is approximately $36.00 per residential dwelling per year.

SECTION II - INTRODUCTION

STATEMENT OF THE PROBLEM

As the population of the United States increases, more people are becoming concentrated in the cities and towns. From 1950 to 1960 the total population of the country increased by about 18.5 per cent. The rural population decreased by a fraction of 1 per cent and the urban population increased by nearly 30 per cent. By the year 2000 the population of the United States will probably double in size from the 1960 census count of 179,323,175. With this tremendous increase in growth in the United States the methods of storage, collection and disposal of refuse are becoming more and more of a problem. The average amount of refuse produced each year is increasing at a rate of 2 per cent per year, compounded by a 2 per cent population growth which results in an overall rate of increase of refuse production of about 4 per cent each year. During 1967 approximately 165 million tons of solid wastes were produced during the year whereas by 1987 330 to 360 million tons of refuse will be produced yearly.

Due to this fast rate of increase in refuse production, many towns and cities have inadequate methods of refuse collection and disposal which creates a serious problem affecting public health and welfare. If our living standards are going to continue to rise, so must our sanitation standards.

The public health significance of a sanitary system of storage, collection and disposal of refuse has long been recognized and recently other areas are causing concern. As towns and cities increase in population it becomes more difficult to obtain land for disposal facilities. The sanitary landfill method of disposal requires a land area that can be used for burying the refuse. This site must be located close enough to the area it serves to prevent long haul distances. The longer the amount of time spent traveling on the road by a collection crew and the vehicle going from the pickup area to the landfill site, the higher is the cost of operation. This high cost of unproductive road travel illustrates the importance of reserving or obtaining land areas large enough to serve as future disposal sites. This would include sites for incineration plants and compost plants or even refuse transfer stations.

The word "waste" refers to useless, unwanted, or discarded materials resulting from normal community activities and it includes solids, liquids and gases. The liquids consist mainly of sewage and the fluids from industrial wastes, the gases are fumes and smoke and the solids are classed as refuse. Solid wastes consist of putrescible and non-putrescible material excluding body wastes. Solid wastes include garbage, rubbish, street refuse, ashes, demolition debris, construction refuse, junk automobile hulks, old refrigerators, stoves and furniture, and the wastes from slaughter houses, canneries, manufacturing plants and hospitals. Available per capita quantities indicate that in Cascade County 75,300 tons of solid wastes will be produced in 1968, whereas by 1988, 187,000 tons will be discarded. The problem of what to do with this waste material is not as critical in Cascade County as it is in many other areas of the United States. Refuse is often handled without regard to sanitation standards, health hazards or area appearance in many communities. The American Public Works Association and the United States Public Health Service conducted a survey which indicated that less than 50 per cent of the cities in the United States with populations of more than 2500 dispose of community refuse by approved sanitary and nuisance-free methods. The survey also showed that approximately 80 per cent of the urban and rural communities with populations between 1,000 and 5,000 dispose of refuse in open dumps. Open dump sites contribute to air pollution, due to burning refuse; and water pollution, due to surface water contamination. They also create potential breeding places for disease-carrying insects and rodents such as flies, mosquitos and rats. Accumulations of litter, refuse and junk cause fire hazards, contribute to accidents, emit unpleasant odors and destroy the beauty of towns, cities and countrysides.

Cascade County has 10 existing refuse disposal sites; 8 of these would now be classified as open dump sites. Many of these sites contribute to air and water pollution, are a source for breeding insects and cause blight areas along the roads. Incineration and composting are not presently being used in Cascade County as a means of community refuse disposal. Another critical problem in the county is the continuous growth of junk automobile graveyards due to the lack of an adequate market for salvaging the scrap. Air pollution, although visible at times, is not currently a large problem in the county.

Storage, collection and disposal of solid wastes could become a major health and economic problem in Cascade County if better methods for handling refuse are not developed and practiced in the near future. Improper disposal of refuse can perpetuate insect and rodent vectors of disease and cause health hazards. An area that does not take care of its refuse problems finds itself overwhelmed by the increased costs involved, lack of suitable space for disposal, lack of proper collection and disposal equipment, lack of suitable legal powers and authorities, and most important, lack of public interest and support.

SOLID WASTE / DISEASE RELATIONSHIPS

Solid wastes have been shown conclusively to be associated with some diseases in the United States. Although the incidence of disease due to wastes is low in this country as a whole, it is demonstrably higher in certain groups -- particularly those without proper waste disposal means. In the chain linking disease from waste to human host, the major point of attack must be upon those wastes which contain disease agents or serve as sources of propagation for carriers of disease. Wastes must be handled or so treated that the pathogens they contain are destroyed -- not merely reduced in numbers -- and carriers of pathogens denied access to the wastes for breeding or for food purposes.

Literature fails to supply data which would permit a quantitative estimate of any solid waste/disease relationship. However, epidemiologic information available does support the claim that to some diseases, solid waste bears a definite well-defined etiologic relationship. The diseases implicated are infectious in nature. Non-communicable disease agents associated with solid waste cannot be substantiated for the most part due to the lack of data.

Where these solid wastes are not disposed of properly and in a sanitary manner, the morbidity and mortality rates from solid waste-borne diseases in a population can be high. Despite the fact that other factors are known to contribute to some reduction of these rates, the inescapable conclusion is that the continued presence in the environment of the wastes themselves is the basic causative factor. Therefore transmission -- whether by direct contact, indirect contact or vector transfer -- is due to environmental contamination by these wastes.

Fly-Bórne Disease

Flies are carriers of many disease agents and recent fly-control experiments indicate that they are significant transmitters of bacillary dysentary (shigellosis) The known ability of flies to reproduce at an enormous rate in organic wastes and then to contaminate man and/or his environment, incriminates the fly as a secondary hazard. The wastes from which the fly arises, or by which it is contaminated constitutes the primary hazard. Any solid waste then which promotes fly production can contribute to an increased incidence of a disease provided the agent for the disease is available, transmission of the agent is possible, and there is close proximity of flies to the required host. Since these contributing conditions may vary from place to place and from human population to human population, the important factor must be the domestic fly population, which in turn is largely regulated by the breeding opportunities afforded by solid wastes.

Some flies, depending on the species, are able to travel from 15 to 20 miles from their propagation source. When aided by air currents these figures may double. Flies are able to carry parasites pathogenic for humans and to transmit them to humans and so cause minor infection. Flies are aided or hindered in this by certain characteristics and factors of human origin, among which are socioeconomic, cultural and personal hygenic practices. When personal or community practices permit accumulations of fly-breeding media, the potential for human infections is increased.

Following are listed some of the more important human diseases found in this area which are said to be transmitted by flies: enteric diseases (typhoid fever, paratyphoid fever, bacillary dysentary and amebic dysentary); tularemia (rabbit fever); conjunctivitis (pink eye); salmonellosis; trachoma; poliomeylitus; hepatitis; and parasitic worm infections.

Rat - Borne Disease

The commensal rat is a known source of zoonoses (diseases of animals transmittable to man), and thriveswherever carelessness in food waste handling and disposal is found. Because of its habits and close association with man, it exposes man to various disease agents which are transferred by direct contact, ectoparasites of the rat, or by contamination of the human environment.

Rats are attracted to, and multiply in, refuse and other associated residues. Rats have also been found at waste disposal sites such as stabilization ponds and poorly operated sanitary landfills.*

Rats harbor ectoparasites which are known vectors of disease, and exchange parasites with other animals that are hosts to disease transmittable to man. Fleas, ticks, and mites frequent rodent nests and burrows of both domestic and wild rodents and are the means of transferring disease from one rodent to another. The arthropods are frequent feeders on man when in proximity to him. Such proximity occurs when man invades the wild reservoir territory or when domestic or wild rodents invade man's domicile. The latter situation is encouraged by careless waste disposal.

The more common human diseases of this area associated with the rat are plague, rat-bite fever, rat-mite dermatitis, rat tapeworm infection, Rocky Mountain spotted fever, salmonellosis, trichinosis, leptospirosis (Weil's disease), tularemia, murine typhus and rickettsial pox.

** A poorly operated landfill could not be considered to be a sanitary landfill. (BSWM)*

Mosquito - Borne Disease

Solid wastes provide a source of breeding media for mosquitos which are the vectors of disease agents pathogenic for man. These mosquitos will deposit eggs in rainwater held in solid waste materials. The organic debris associated with solid wastes serve to nourish the mosquito larvae either directly or indirectly by permitting the growth of microorganisms upon which the larvae feed. In the presence of infected hosts, the emerging adult mosquitos will become infected and transmit the disease agent to human hosts.

Only two diseasesare associated with mosquitos in the United States, malaria and encephalitis. The latter is of greater importance in this area.

Safety Aspects

There is strong evidence that solid waste handling is a hazardous occupation because insufficient attention has been paid to prevention of injury among sanitarian workers, salvaging personnel and to children who frequent such areas for recreational purposes. There is also reason to believe that some of the high rates of injury are due in considerable degree to the absence of or limited safety programs. Some of the more important hazards associated with solid waste disposal sites are vehicular operations, dust, fires, contamination, explosives, mechanical hazards, pesticides, and poisons.

HISTORY

Systematic methods of collecting and disposing of refuse are relatively new in the civilized world. The ancient civilization disposed of some refuse by dumping and periodic burning of the material. Collection and disposal of solid wastes was not commonly practiced in major cities of the world until the

19th Century. It was not uncommon prior to that time for the people living in the cities to dump their refuse and excrement into the dirt streets to combine with the animal droppings. During the Middle Ages in many cities and towns in Europe the streets were littered with large amounts of refuse. It is believed that many epidemics and plagues which swept across the countries during that period were a direct result of the lack of sanitary methods of refuse disposal.

There were some local ordinances against open dumping in cities of the western world but there was no enforcement of the laws until bacteriology and epidemiology studies laid the foundation for today's sanitary science. These studies indicated that there is a direct relationship between unsanitary disposal methods and transmission of diseases through flies, mosquitoes, rats and other vermin causing numerous health hazards.

The actual disposal of refuse by open dumping and burning goes back many years to ancient times. The disposal of garbage by feeding it to hogs as well as the disposal of inorganic wastes in fill areas are also both ancient methods of refuse disposal. The practice of composting refuse to form a soil conditioner can be traced back to the Kouloure pits in Cnossus, an ancient capital of Crete, which existed some 40 centuries ago. Refuse disposal by burying goes back to biblical times and probably goes back before that period. This would be the forerunner of our modern sanitary landfill type method of disposal. During the latter parts of the 19th Century the first fired furnaces were designed for burning refuse. Since that time a great deal of progress has been made in the design of large incinerators with pollution control on flue gas emissions. In the early 1920's garbage grinding was introduced as a method of disposal.

The most common present day methods of disposal consist of (1) the sanitary landfill method of compacting and daily burying the refuse with cover soil; (2) the incineration method of controlled burning of the refuse with burial of the ash residue; (3) the compost method of decomposition of ground-up refuse, after the non-decomposable material has been removed, to form a soil conditioning material; and (4) the salvage method of reclaiming the saleable material and disposing of the remaining refuse by one of the other methods of disposal. Engineering planning for refuse disposal has not been practiced in many areas until recently.

In the past, refuse disposal has been ignored and left undeveloped until a crisis has occurred and only then was a temporary solution sought for the problem. People only recently began to realize that it is necessary to plan and develop programs for storage, collection and disposal of refuse in order to get good sanitation, esthetics, economy and service for the public. The larger urban areas were the first to realize the magnitude of the refuse problem and several engineering studies have been done by these larger cities concerning refuse collection and disposal.

The disposal problem has reached serious proportions due to the steady disappearance of available land for landfill sites, the more rigid air, water and land pollution controls and the decline of the markets for salvageable items such as ferrous metal and paper products. It was at this point that the United States Congress passed the "Solid Waste Disposal Act" (Public Law 89-272) on October 20, 1965. The purposes of the Act are:

1. To initiate and accelerate a national research and development program for new and improved methods of proper and economic solid waste disposal, including studies directed toward the conservation of natural resources by reducing the amount of waste and unsalvageable materials and by recovery and utilization of potential resources in solid wastes; and

2. To provide technical and financial assistance to State and local governments and interstate agencies in the planning, development, and conduct of solid-waste disposal programs.

The Solid Waste Disposal Act authorizes action in 6 areas. It provides for (1) up to 2/3 support for local and State projects to demonstrate new and improved waste disposal technology; (2) a comparable level of Federal aid for the development of area-wide solid waste management systems to end fragmentation of disposal responsibilities among small communities; (3) up to 50 per cent support for State surveys of solid waste requirements; (4) research to lay the basis for new approaches to solid waste disposal without the health or environmental hazard; (5) training programs to alleviate critical shortages of qualified personnel; and (6) technical assistance to local and State governments with solid waste problems. Under the Solid Wastes Disposal Act the Federal Government supports the local and State agencies in attacking the solid wastes problem, however, the responsibility for carrying out programs for improved practices is left mainly at the local and State levels.

In addition to the changes in methods of collecting and disposing of refuse that have developed over the years, there have also been definite changes in the quantity and quality of the solid wastes produced. Several years ago food wastes or garbage contributed the major portion of refuse. Now there are an increasing amount of throw-away items on the market such as paper, cardboard, plastic, aluminum and tin food containers, glass and tin beverage containers and other types of packaging materials which all contribute to the quantity and quality of the refuse. The percentage of food wastes or putrescible garbage in the total refuse collected has continually decreased due to the increase of throw-away cartons and containers. Another cause of the decrease of food wastes in collected refuse is the introduction of kitchen sink garbage disposal units, now being used in many areas, which dispose of the food wastes through the sanitary sewer system. Printed material such as newspapers, magazines and throw-away advertising also are on the increase and form a large portion of the total refuse collected. The total amount of refuse produced per capita continues to increase at a much faster rate than it has in the past which indicates the necessity of planning for future disposal sites and devising better methods of disposal.

STATE LEGISLATION AND DEFINITIONS

During the 1965 session of the Montana Legislature it was declared the public policy of this State to control refuse disposal areas to protect the public health and safety. Sections 69-4001 to 69-4010 of the State Code, Control of Refuse Disposal Areas, were passed by the Legislature. On February 11, 1966, the Montana State Department of Health adopted Regulation 52-46, Regulation Governing the Control and Licensing of Refuse Disposal Areas, to set standards for proper sanitary refuse disposal. Experience has demonstrated that public health problems are often associated with the improper disposal of refuse in urban and rural areas.

PURPOSE AND SCOPE OF REPORT

In requesting that all disposal sites in Cascade County comply with the above adopted standards, the City-County Health Department did considerable investigation of the conditions of the refuse disposal sites throughout the county. It became evident from the findings and from discussions with community and county officials that problems associated with solid wastes were not going to be easy to resolve. The majority of the disposal sites were inadequate and did not meet the minimum requirements as set forth by the Montana State Department of Health. Since the problems are not confined to individual communities but involve areas, it is difficult to make valid recommendations to the individual communities. This indicated a definite need for a comprehensive plan based on current as well as anticipated needs. The Board of Commissioners made application to the Public Health Service for a study grant. A grant was approved for a "Comprehensive Study of Solid Waste Disposal - Cascade County, Montana", with authorization to commence work on June 1, 1967.

The objective of the study is:

1. To investigate and define existing conditions as to solid waste storage, collection and disposal in the county.
2. To determine the most economical, efficient and effective methods for storing, collecting and disposing of solid wastes in the county.
3. To implement study findings by preparing a comprehensive solid waste disposal report for Cascade County.

The study was conducted through the joint efforts of the County of Cascade, City of Great Falls, City of Belt, Towns of Cascade and Neihart and the consulting engineering firm, Thomas, Dean & Hoskins, Inc.

IMMEDIATE AND LONG-RANGE SOLUTIONS

Sanitary collection methods and disposal sites are an immediate necessity for Cascade County. However, as land becomes more expensive and population continually increases, it becomes more apparent that for health reasons as well as economics, it is necessary to design collection and disposal facilities for long-range use. As the towns and cities grow, the distance from the center of population to a rural or out-of-town disposal site continues to increase until it becomes uneconomical to have collection vehicles travel the extra distance. By this time it is also difficult to locate a site for refuse disposal facilities within the developed area of the town or city. As a result, the total cost of operating the disposal system increases due to the higher cost of the land site in the developed area or the extra cost of the longer collection vehicle haul distances. The cost of solid waste disposal can be kept to a minimum by obtaining future disposal sites before the area gets developed and the cost gets unreasonable.

The disposal of junk automobiles also needs immediate attention. Throughout the county the junk automobiles have accumulated without adequate methods of disposal. It will require additional effort to dispose of the existing junk automobiles around the county due to the long period of time they have been allowed to accumulate. However, a long range program for continuous removal will have to be developed to keep the county rid of these unsightly junk cars and automobile graveyards.

Air pollution laws and restrictions are now coming into effect, and although air pollution is not a current problem in Cascade County, it could develop into one with increased population and industry. The enforcement of necessary air pollution controls now will prevent any long-range problems from developing.

A practical refuse control program can be accomplished through the combined efforts of the people in any community or area. However, much more than technical knowledge is involved in setting up a successful program of refuse sanitation. Before technical solutions can be put to work, it is necessary for the citizens to understand the need for adequate and safe refuse practices. Civic improvement in health and safety is seldom brought about by laws enforced by the police, but rather, by the desire and cooperation of the citizens to improve their community. People become more aware of existing problems when rats and flies create obvious hazards, or when their children play in hazardous junk piles. When the communities and populated areas are aware of the difficulties or dangers connected with inadequate or unsanitary refuse storage, collection and disposal, then is the time for a workable program to be initiated. In all cases, it is essential that the people affected by the solid wastes program in Cascade County be informed of why this study is being made and what the solutions will be. Once the solutions to the solid waste disposal problems have been developed, it will require not only an initial effort, but a continued effort, on everyone's part to make the workable program a success.

SECTION III - EXISTING CONDITIONS

The existing methods and conditions of storage, collection and disposal of refuse are indicated here for each individual town or city in Cascade County. Conditions of the storage and disposal sites vary with the seasons in Montana. During the warm summer months the open dump sites are potential breeding places for vector such as flies and mosquitoes, are potential fire hazards and they emit offensive odors. In the cold winter months the same sites have no fly, mosquito or odor problems and fires are easily controlled.

The yearly total average rainfall for the county varies from approximately 14 inches at Great Falls to 28 inches at the Kings Hill reporting station in the southeastern tip of the county. Snowfall is heaviest in the mountainous areas with an average of 270 inches falling at the Kings Hill reporting station per year while Great Falls receives an average of only about 55 inches per year. The county-wide temperature varies, with Great Falls maximum and minimum recorded temperatures for the last 70 years being +107° and -49°, respectively, whereas a 16 year record at Kings Hill gave the maximum-minimum temperatures recorded at +90° and -41°, respectively.

Although the vector, odor and fire problems are of little concern during the winter months, the heavy winter snow as well as the melting spring snow makes many access roads to disposal sites impassible during as much as 6 months out of the whole year. Many of the areas in the county have a clay type soil which becomes very slick when wet, thereby making roads impassible. Gravel or asphalt surfacing is required on roads in these areas in order to insure year around accessibility. A unique weather aspect of this area is the chinook warming wind that causes considerable temperature variances throughout the year This wind which originates on the Pacific Coast and descends down the Montana side of the Rocky Mountains has been known to increase the temperature as much as 25° in only a few minutes. Chinook winds occurring during the winter months sometimes cause the frozen clay soil to thaw and becomy muddy Even though winter weather causes some access problems, the majority of the well traveled roads in Cascade County are kept open throughout the year, with only brief periods of closure due to hazardous snow conditions. The condition of the access roads to the dump sites from the highways and county roads causes some of the problems that have developed in Cascade County. Individuals who are unable to drive their vehicles to a refuse disposal site because of mud or snow have a tendency to dump refuse along the access road or in other unauthorized areas.

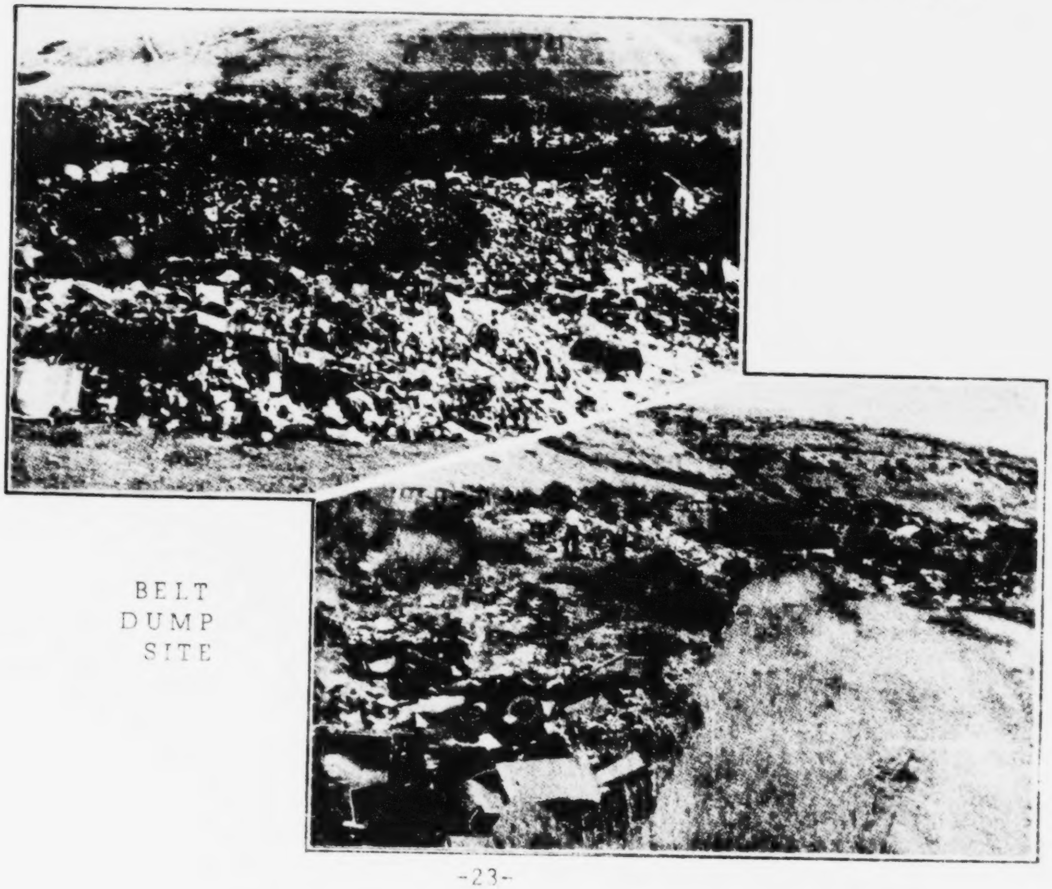
Winds are not at all uncommon in this area during the summer and winter months and any existing dump sites located on hill tops or knolls develop a blowing paper problem. The papers and refuse may not blow into a populated area but they do litter the countryside. The majority of Cascade County is a treeless, rolling prairie-type terrain with only the southern mountainous portion of the county supporting a tree cover. Due to the lack of tree cover the winds blow unchecked throughout most of the county so any open dump sites or even sanitary landfill sites located on high unprotected areas are subject to a great deal of wind. Obtaining a future site becomes more difficult when the public has seen the littered area around an existing site. Fencing will control some blowing papers if the wind is not too gusty or strong.

Storage and collection of refuse also represent a problem throughout the county. Presently only two cities in Cascade County have organized collection systems with the remaining communities disposing of their refuse on an individual basis. Infrequent disposal of refuse, coupled with inadequate storage facilities, produces high potential health hazard areas. From a health standpoint these unsanitary refuse storage areas are more critical than the inadequate disposal sites because they are always located near a dwelling unit. People are constantly in direct contact with their own storage area and therefore subject to these unsanitary conditions if they prevail. In a relatively populated area such as a small community, one unsanitary refuse storage area can be a health hazard to the whole surrounding area. Storage, collection and. disposal of refuse are all important phases of refuse handling and deficiencies in any phase can represent a hazard from a health standpoint.

The Cities of Belt and Great Falls and the Towns of Cascade and Neihart make up the incorporated cities and towns in Cascade County. The unincorporated communities that have existing refuse disposal cites are: the Fort Shaw-Simms-Sun River area, the community of Monarch, the Sand Coulee-Tracy area, the Stockett-Centerville area, the community of Ulm and the community of Vaughn.

BELT

The City of Belt has a population of 900 and is located in the east portion of the county near U. S. Highway 87 - 89. Refuse is collected under a private contract and is disposed of at a site owned by the City of Belt and located 1-1/2 miles north of the city on the lower Belt Creek road. Refuse is stored at the homes in many different size containers as there is no ordinance governing the size to be used. The environmental sanitation survey made by the City-County Health Department in July of 1968 revealed that 44 per cent of the homes and businesses were using inadequate refuse storage containers. Also 38 per cent were burning refuse on their premises. Rubble was evident on 68 per cent of the premises. Contract collection is performed by a private collector who picks up refuse twice a week using a pickup truck. The city-owned disposal site is located about 300 feet west of the paved Lower Belt Creek road and covers 3.1 acres. Table 6 indicates that there is limited future usage at this site. The short access road into the area is graveled and adequate for vehicle use except at certain times during inclement weather. Dumping at unauthorized sites occurs in the area around Belt; however, this is not caused by the short periods of closure of the dump site during bad weather. The site would be classified as an open dump site with the refuse being covered with soil once or twice a year. Woven wire fencing exists on 3 sides of the site and a barbed wire fence covers the fourth side. There are no signs to indicate the areas to be used for dumping and the people tend to dump refuse throughout the entire area. There are no special areas designated for disposing of junk automobiles, appliances and scrap metals. All the refuse is mixed together in the disposal area. Any papers that are picked up by the wind will probably not be deflected and confined to the disposal area by the woven wire fencing due to the terrain of the site. The refuse is dumped in some pre-dug trenches but a good portion of the refuse is dumped on the side of the hill, and winds tend to blow the paper over the fences and out into the adjacent fields. There is no local program for insect and rodent control and flies are numerous throughout the site during the warm summer months. Rats could be a problem but none have been sighted in the area. The area is open to the public 24 hours a day. Surface water flow and ground water flow are no problem on this sloping hillside area. Stream pollution would not be a problem due to the location of the site. There are a few junk automobile hulks at this disposal site. Since there is a junk yard dealer in the area who purchases old cars for salvage parts, this helps prevent disposal of automobile hulks at unauthorized sites. Located in and around Belt there are approximately 227 junk automobile hulks that could be scrapped.



BELT
DUMP
SITE

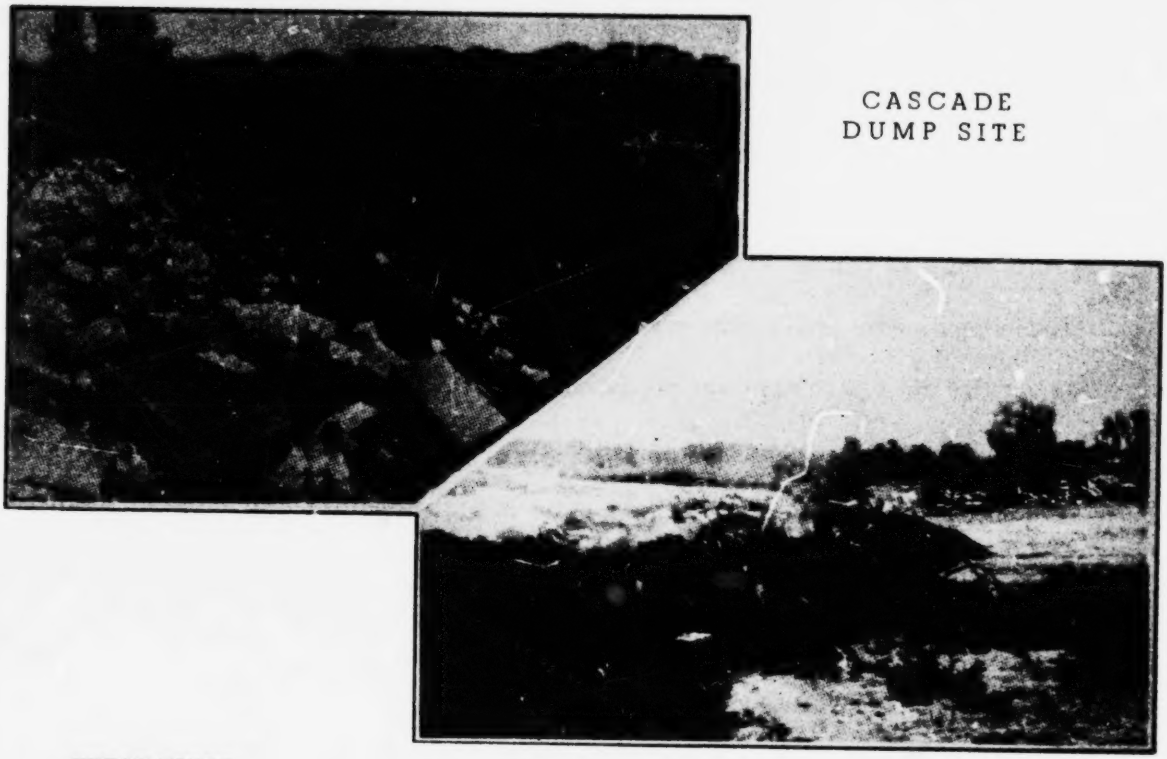
CASCADE

The Town of Cascade with a population of 730 is located in the southwestern section of the county along Interstate Highway 15. Treeless rolling prairie type terrain makes up the area surrounding Cascade with the edge of the Rocky Mountain Range approximately 8 miles to the southwest. Cascade has no ordinance governing storage of refuse at the homes so there are no requirements controlling the size of refuse containers used. The environmental sanitation survey performed by the City-County Health Department indicated that 41 per cent of all the residences and businesses utilized poor refuse storage containers and 38 per cent had rubble on their premises. Refuse burning was being practiced on 29 per cent of the premises. The lack of ordinances stems from the fact that the pickup or collection of the refuse is left entirely to the homeowner. Every individual must dispose of his own refuse as often as he feels is necessary and by use of his own vehicle. The disposal site serving the Cascade area is located 1/2 mile northeast of town along the old Ulm-Cascade Highway 91 and near the Missouri River. The Town of Cascade owns the existing disposal site which covers an area of 3.8 acres. Enough volume is available there for about 10 years future usage as given in Table 6. The site terrain slopes toward the river with the relatively flat area being used for disposal and the steeper portion forming the bank of the river. The refuse is kept back from the edge of the river. This type of disposal would be classified as a controlled open dump site since the refuse is dumped in specified areas although soil is seldom used to cover the refuse. A sign directs one to 2 separate areas for dumping old car bodies, appliances and scrap metal. The garbage and other house wastes are dumped in a dug trench and generally are not spread over the whole disposal area in a disorderly fashion.

A person going to the disposal site travels on a paved road to the site location and then on an unpaved road a short distance through the site to where he can dispose of his refuse. The roads are accessible throughout the year and inclement weather does not isolate the site. The area is open to the public 24 hours a day. The majority of dumping is confined to the disposal site with little dumping occurring at unauthorized locations. Fencing consists mainly of barbed wire and does not encircle the entire area. Papers and other lightweight material blow away from the area.

During the warm summer months flies are prevalent around the refuse. Rats are no problem; none have been sighted at this location. Warm temperatures combined with the exposed refuse causes offensive odors in the immediate area and creates a fire hazard as well. With proper control of the dumping and subsequent covering of the refuse with soil, there should be no problem of water pollution resulting from surface or ground water runoff.

Junk automobile hulks total about 137 inside the city limits and on the surrounding farms and river banks. (See photos next page).



CASCADE
DUMP SITE

GREAT FALLS

The City of Great Falls is located in the north-central portion of Cascade County at the intersection of Interstate 15 and U. S. Highways 87 and 89. Great Falls is one of the two largest cities in Montana with a population of 76,000. The major industries, in terms of employment, supporting the economic base of Great Falls are: (1) Malmstrom Air Force Base; (2) the Anaconda Company; (3) wholesale and retail trade, and (4) agriculture. The terrain in the surrounding area consists of low rolling hills supporting a grass cover and generally void of tree life. Land use there consists mainly of farming, with some ranching, usually as a side line to farming.

Great Falls Ordinance No. 1375 pertaining to refuse storage, collection and disposal specifies that garbage containers for other than bulk accumulation shall not exceed 55 gallon capacity or weigh more than 45 pounds, and that fly tight covers, attached by a chain to a stationary object shall be used for covering the containers. See Ordinance No. 1375 for other limitations pertaining to the storage, collection and disposal of refuse. Data obtained from an environmental sanitation survey covering the entire City of Great Falls indicated that only ±27 per cent of the containers used for storage of refuse were 30 gallon galvanized containers whereas the majority of the remaining ±73 per cent were 55 gallon barrels. Eighty five per cent of these containers are stored in alleys for collection whereas the remaining 15 per cent are set out by the curb for street collection.

Collection of refuse in Great Falls is done by the City in specified areas and by a private contractor in the remaining area within the city limits. The private contractor charges and collects his service fee from the individual homeowner and in turn pays the City of Great Falls a dump fee for using the city landfill site for disposal. Charges for collection of refuse by the City of Great Falls range from $13.90 up to $33.10 for a residential home based on the number of rooms per dwelling. This charge is for once a week pickup throughout the year. The private contractor service charges a flat rate of $2.00 per month for twice a week pickup in a residential area. The City of Great Falls uses mostly 18 cubic yard mechanical packer vehicles for collection routes. The private collector also uses enclosed mechanical packer units.

Individual outdoor home burners or incinerators are allowed in Great Falls, for burning combustible material, when approved by the Fire Marshall. All indoor incinerators have to be constructed according to the Uniform Building

Code. The Great Falls City Code (Section 8-10-4) states "No person shall burn garbage, swill, or rubbish at any place, or in any manner violating a provision of the sanitary code or likely to create a health hazard or a nuisance. In the near future the Montana State Department of Health expects to have restrictions on emissions of particulate matter from incinerators. This will place additional controls on indoor and outdoor incinerators. An environmental sanitation survey made by the City-County Health Department indicated that there are presently 299 incinerators in the City of Great Falls and 162 in the fringe area.

The disposal site for refuse is located 1.5 miles northeast of town near the Rainbow road. It is confined to the low areas of a coulee in the Northeast Quarter of Section 32, Township 21 North, Range 4 East and lying north of the Rainbow county road. The site is owned by a private individual who farms in that area and the city has a renewable lease for the land use. The site covers 105 acres and consists of a drainage course or coulee which originates at the west edge of the 1/4 Section and transverses the entire 1/2 mile of the area. Refuse is being dumped, compacted and buried at the upper end of the ravine and will progress downward through the area in the future. After all the low-lying areas are filled, the owner plans to use the site for farming. Depending on the depth of fill requested by the owner, this site could last about 7 more years. See Table 6.

Refuse appears to be separated into 3 dumping areas throughout the site. Refuse from city and private collection vehicles is disposed of at the upper end or west end of the ravine, whereas larger refuse such as combustible rubbish is dumped in the center area. The ferrous material such as scrap metal, old appliances and junk automobile hulks are piled in the lower or east end of the area for crushing and subsequent burial. The refuse from the collection vehicles is compacted and buried daily. A gravel surfaced road into the disposal site from the paved Rainbow road allows year around accessibility to the site.

An equipment operator is at the site all day long, 5 days a week, and he directs people to the proper dumping areas when possible. The site is open 24 hours a day throughout the year so people dumping refuse in the early morning, late evening or on weekends dump refuse at their own discretion. There are no signs on the site specifying where material can be dumped. There is a small sign on the Rainbow road indicating the direction to the disposal site.

The existing site is not fenced and blowing papers are a problem in that some of them blow across the wheat fields. Many of the blowing papers settle in the small ravines at the disposal site. The prevailing winds are from the southwest and blow paper away from town and the populated areas.

Insects are not too numerous at the Great Falls sanitary landfill* since the garbage is covered daily. Rats are non-existent there. Burning of the rubbish occurs almost daily and could cause a fire hazard during the summer. Stream and ground water pollution is unlikely due to the grade of the ravine and the method of disposal.

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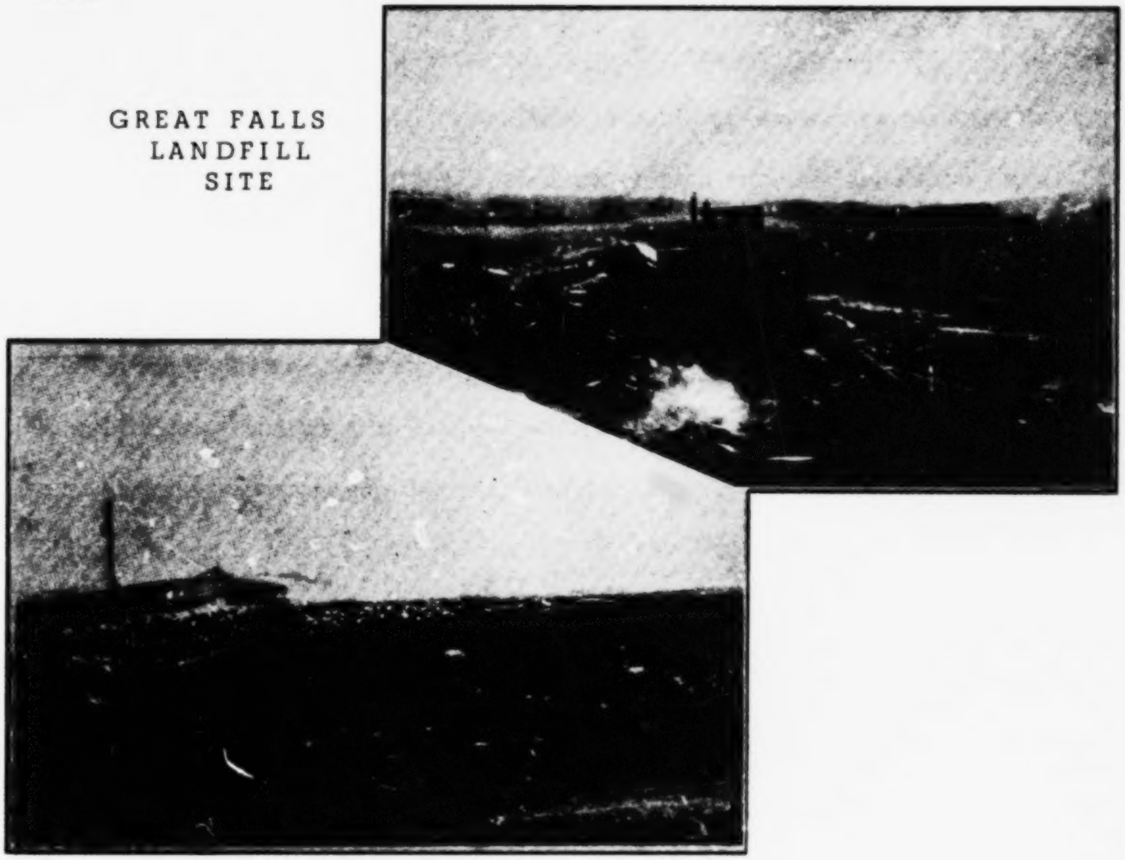
* *Operating practices at this facility make its designation as a "sanitary landfill" inappropriate. It should, rather, be termed a "landfill." (BSWM)*

Salvaging of resaleable material is allowed under city control and permission is given to only one firm. The firm doing the salvaging pays a fee to the city for the salvage rights. The method of salvaging the material appears to be satisfactory as the collector never hampers any of the other activities in the area.

Junk automobile hulks are disposed of at the landfill site after partial crushing. However, the site is limited in the number of hulks that can be buried there. In the Great Falls metropolitan area there are an estimated 1,500 junk cars located in automobile graveyards, along river banks and behind houses. These old hulks are unsightly and if not cleaned up in the future will surely devaluate the surrounding land to a great degree. Once several automobiles have been allowed to pile up in an area, the area becomes labeled as an automobile graveyard and future dumping is almost impossible to control. The City-County Health Department made a junk automobile count within the Great Falls city limits during February, 1968, and 1,350 cars were counted. Great Falls city Ordinance No. 1487 prohibits the abandonment of non-operating or wrecked vehicles on property in the city limits, but a person can keep a wrecked vehicle in his garage. A non-operative car can be kept in the backyard providing the vehicle is being restored, and is not inoperative and outside the garage for more than 6 months following proper notice of violation of the Ordinance. When the grace periods specified in the ordinance have elapsed, the city can have the non-operating vehicle impounded until lawfully claimed or can dispose of it according to the official code. The Great Falls landfill site can be used to dispose of a limited number of car bodies. The majority of the space at the landfill site is to be used for disposal of solid waste other than old automobiles. The exclusion of the majority of the large junk car hulks will prolong the life of the landfill site.



GREAT FALLS
LANDFILL
SITE

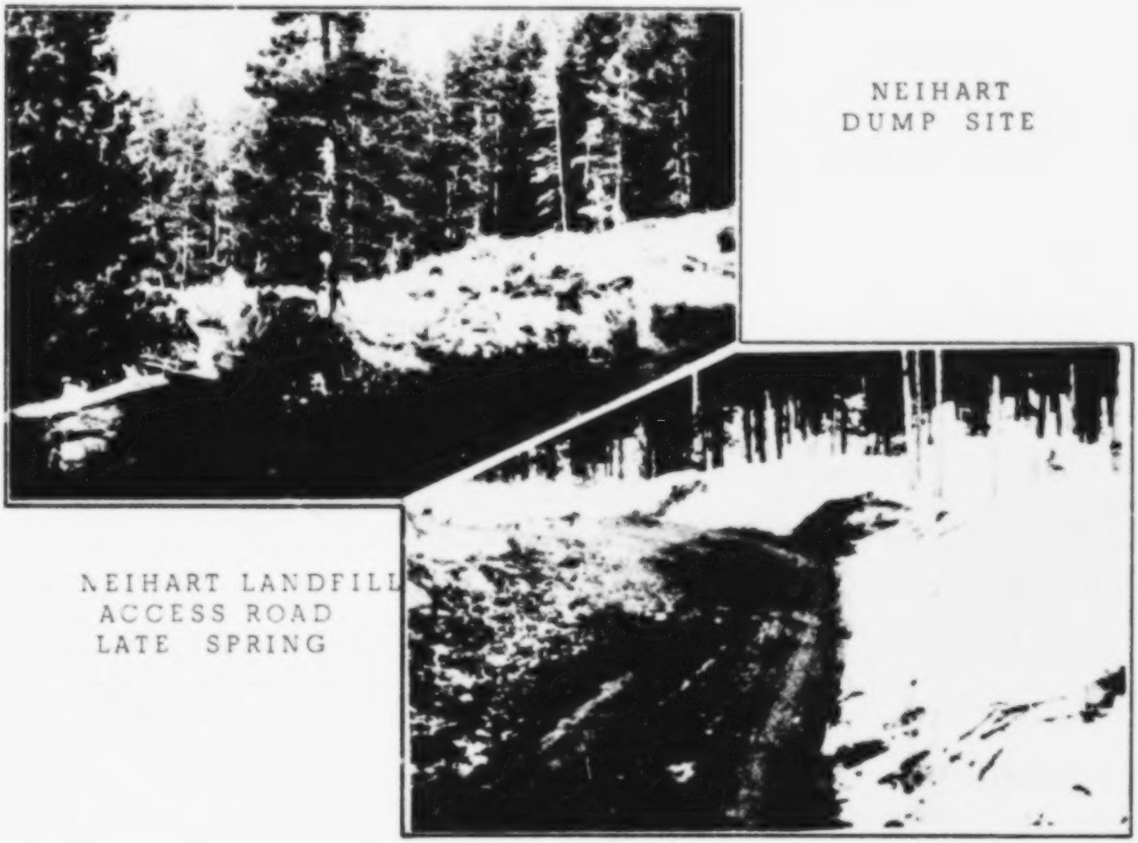
NEIHART

The Town of Neihart is located in the southeastern corner of Cascade County on U.S. Highway 89. The population there has fluctuated tremendously depending on the mining conditions in the area, the summer tourist trade, and the winter skiing trade. The incorporated town of Neihart has a population of 170 which falls off in the winter and increases in the summer in conjunction with the tourist trade and influx of summer cabin owners. The elevation of Neihart is approximately 5,635 and the surrounding terrain consists of rugged mountains covered with growths of evergreen trees.

Refuse storage is the responsibility of the individual, resulting in varied sizes of containers being used. There is no limit to size and there are no ordinances governing storage of refuse at the homes. The City-County Health Department's environmental survey indicates that 51 per cent of the business and residential premises have inadequate refuse storage containers and 56 per cent have rubble around the area. Burning is practiced on 41 per cent of the premises. Collection and disposal of the waste is taken care of by the individual when he feels it is necessary. The disposal site is located about 1 mile southeast of Neihart on U. S. Highway 89 and approximately 700 feet northeast of the highway. The Town of Neihart owns 20 acres in the area and the disposal site is located on a small portion of this. The site is on a fairly steep sideslope of the mountain and the lightly graveled access road is usually impassible during the winter months due to the snow accumulation. When snow removal equipment opens the road, the area is accessible to trucks only. The access road is plowed open several times during the winter months and homeowners must use the facility at this time or continue to accumulate their refuse at their own home.

The disposal site is an open dump site located in a small clearing in the evergreen trees. It is open 24 hours a day but due to the inaccessibility of the road in the winter, there is some dumping along the access road and at other unauthorized sites. There are no signs to indicate the site location or to control dumping at the site. Junk car hulks, scrap metal and all other refuse are mixed together at the same location. The heavier materials such as the car bodies have a tendency to roll down the steep hill until they come to a stop against the trees below. The site is not fenced but there is no problem with blowing papers due to the trees forming a protective barrier against the wind. Flies are numerous at the site during the summer and there is also a noticeable refuse odor that develops at all open dumps in warm weather. However, no residents are near enough to the site to be affected by the odor. Because of the tree growth in the immediate area, fire at this site could be disastrous. Stream and ground water pollution are very unlikely because of the location of the dump site in relation to the existing streams and ground water table.

A junk auto count revealed 25 abandoned vehicles in the area.



NEIHART
DUMP SITE

NEIHART LANDFILL
ACCESS ROAD
LATE SPRING

FORT SHAW-SIMMS-SUN RIVER

The communities of Fort Shaw, Simms and Sun River are located on State Route 200 in the northwest portion of the County. The total population of these three communities is 430. Terrain around this area consists of gentle knolls with grass cover and the majority of the area is treeless except for deciduous trees along the creeks.

The environmental sanitation survey made by the City-County Health Department revealed that 87 per cent of the business and residential premises have inadequate refuse storage containers and 67 per cent have rubbish around the area. Burning is practiced on 80 per cent of the premises. Disposal of the refuse is left up to the homeowners. A disposal site serving the three communities is located on the Doctor Russell Road about 1 mile southwest of Fort Shaw. The site is owned by the Fort Shaw Irrigation District and it covers 3.4 acres. It is located on top of a small knoll with no protection against the wind, and blowing papers are difficult to control. The refuse at the open dump site is covered with soil only when brought to the attention of the county and it appears this is not very often.

The county access road is graveled and the site is open 24 hours a day. A large sign appears at the entrance to the site but it is not readable due to destruction and wear. There are no signs within the enclosed area to separate dumping areas for large waste material from household wastes. Even though the site is open 24 hours a day there is still some dumping at unauthorized sites outside the enclosed area. Woven wire fencing is used to enclose the site and prevent papers and trash from blowing out of the enclosure. However, the portion of the site that is used for the majority of the dumping is located on top of the knoll with the surrounding fence at a lower elevation.

During the summer very unsanitary conditions exist with decaying refuse giving off offensive odors. Flies and mosquitoes are numerous, and breed extensively in the refuse. Pollution of streams or ground water is not likely due to the location of this site.

Junk car hulks are, for the most part, piled along one side of the disposal site. It would be difficult to dispose of very many junk cars there because of the excavation required to completely bury the hulks. A junk car count in the Fort Shaw-Simms-Sun River area indicated approximately 100 cars deposited along stream banks, behind homes and down in coulees.

FORT SHAW DUMP SITE

MONARCH

Monarch is located on U. S. Highway 89 in the southeastern portion of the county. Summer and winter population varies in this area due to the summer tourist travel and mountain cabin inhabitants. The winter population is 27 with the summer population reaching 170.

Refuse is stored and disposed of by the homeowner since there is no collection service available. The environmental sanitation survey made by the City-County Health Department revealed that 53 per cent of the businesses and residences had inadequate refuse storage containers and 38 per cent had rubble on the premises. Thirty-two per cent of the homeowners burn their refuse at home in backyard burners. The 1.5 acre disposal site serving this area is located 1.5 miles east of town and approximately 500 feet north of the Hughesville road on a gentle slope at the base of a mountain ridge. The existing site will adequately serve the area for the next 9 years as indicated in Table 6. The United States Forest Service owns the site and the county maintains it. Refuse is dumped at the edge of the fill and periodically covered with soil removed from the sideslope of the mountain. The access road is graveled and adequate for year around use. A good sign identifies the site and specifies what can be dumped in the area. The site is open 24 hours a day and there does not appear to be dumping at unauthorized areas. The lower portion of the disposal area is fenced on 3 sides with a well constructed woven wire fence to prevent blowing papers from leaving the area. The combination of the surrounding trees, forming a wind barrier, and the fencing seems to prevent papers from blowing away from the area. Flies are noticeable at the site although not as numerous as at most of the sites around the county. Fire could be a problem here if the refuse ignited and spread to the trees in the area surrounding the site. The tree cover is not as heavy as at Neihart and could possibly burn itself out before causing extensive damage. Stream and ground water pollution are not probable at this sidehill location.

There are no junk cars at the disposal site and a car count indicated only 8 hulks around the Monarch area. It would be difficult to attempt to dispose of very many junk cars at the existing disposal site.

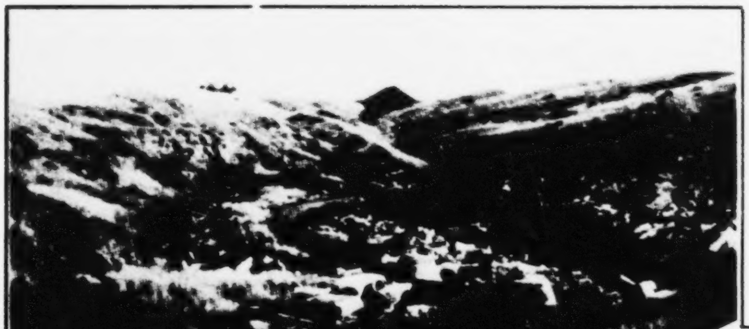
MONARCH LANDFILL SITE

SAND COULEE-TRACY

The Sand Coulee-Tracy area is located in the east central section of Cascade County on Route 227. Sand Coulee has a population of 350 and the population of Tracy is 200. These communities are located in a farming area consisting of rolling, grass covered hills with little tree growth. There is no collection service and individuals store and haul their own refuse to an open dump site located above the community of Sand Coulee. The environmental sanitation survey conducted by the City-County Health Department indicated that 82 per cent of the business and residential premises had unsatisfactory refuse storage containers and 59 per cent of the premises had rubble on them. Sixty-two per cent of the homeowners attempt to reduce the volume of their refuse by burning. However, inadequate combustion usually results in a fly problem around the burner. The disposal site of 5.0 acres is one mile south of Sand Coulee and forms along the bottom of a ravine owned by Mr. Ernest Chartier who also owns the surrounding land.

Refuse is dumped indiscriminately throughout the bottom of the ravine which extends more than 0.3 of a mile in length. The county gravel road passes close to the site . During periods of wet weather the access road between the county road and the diposal site becomes muddy and impassible. The area is open to the public at all times. There are no signs specifying the ravine as a disposal site or indicating specific places for dumping along the ravine. Disposal of refuse at unauthorized sites is evident around the Sand Coulee-Tracy area. Blowing papers are not too much of a problem since the site is in a coulee protected from the wind. Insects are prevalent throughout the warm summer months due to the unburied garbage.

A spring fed stream flows through the bottom of the ravine and surface water pollution is apparent from the refuse floating in the stream. The polluted water flows through the center of Sand Coulee and is a health hazard to all the people who use the water. Drainage from this area discharges into the Missouri River upstream from the intake for the Great Falls water system.



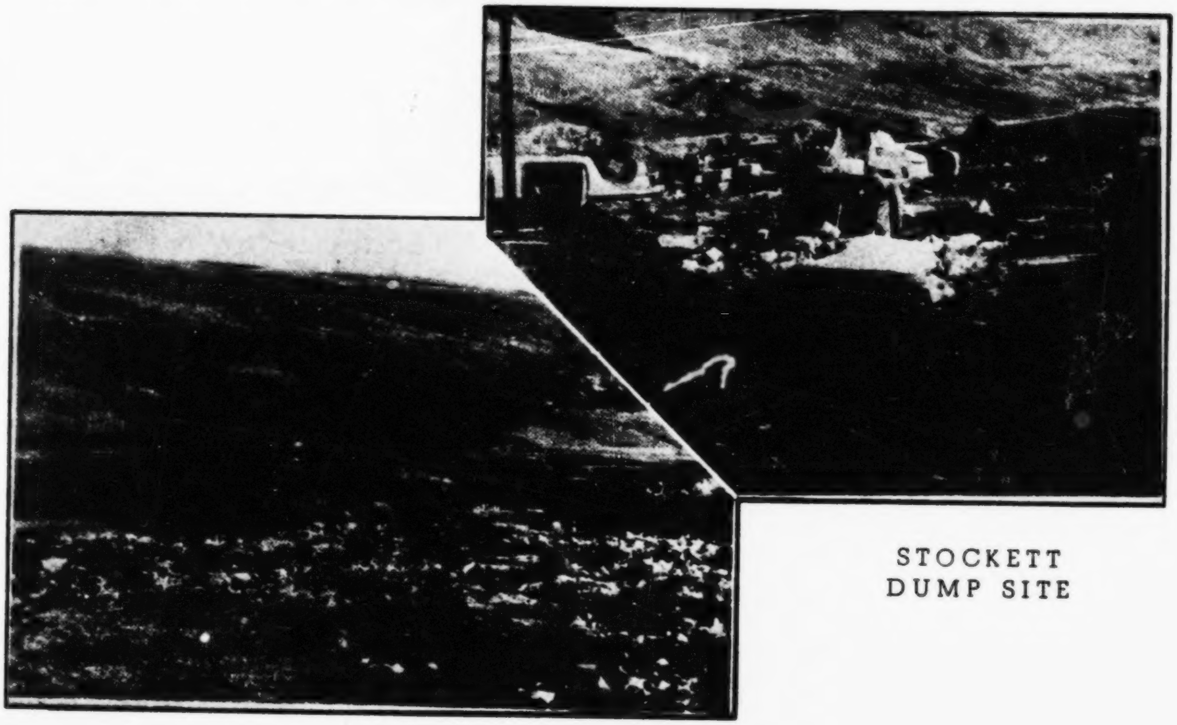
SAND COULEE DUMP SITE

SAND COULEE CREEK FROM DUMP SITE

STOCKETT-CENTERVILLE

The Stockett-Centerville area, with a population of 565, is also located in the east central portion of the county on Route 227. The grass covered land surrounding this area is primarily used for farming. Coal mining was evident throughout this area for many years but the coal mines are no longer in operation. Individual homeowners store and dispose of their own refuse as they feel necessary. The environmental sanitation survey revealed that 82 per cent of all the residential and business premises had inadequate refuse storage containers and 54 per cent had rubble on the premises. Sixty-eight per cent of the homeowners attempt to reduce the volume of refuse for disposal by burning. An open dump site of 3.6 acres is located 1/2 mile west of Stockett on property owned by Robert Klasner. Paper and rubbish is spread over a large area, not only through indiscriminate dumping practices, but by the wind as well. Fencing is non-existent in the area. There are no signs to indicate the location of the site or to control the dumping areas. The site is open 24 hours a day but the impassible condition of the poor access road often isolates the site. As a result, dumping occurs at unauthorized places around the Stockett-Centerville area. Insects are prevalent around the exposed refuse in the summer. Water pollution is not probable since the site is located on top of a hill.

Junk automobiles are numerous around Stockett with approximately 54 being counted in the area. The Centerville count came to 16 cars.



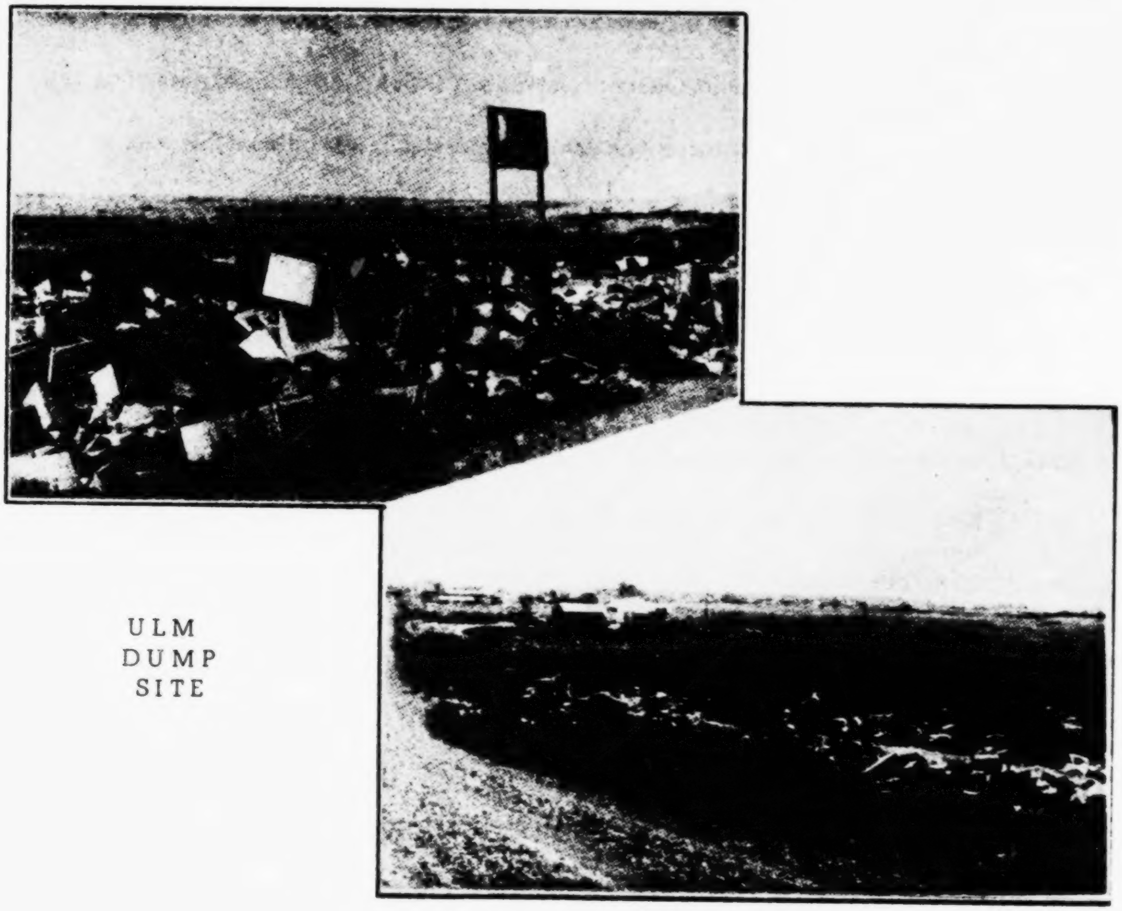
STOCKETT
DUMP SITE

ULM

Ulm, with a population of 415, is located in the west central area of the county along Interstate 15. This is also a farming area with relatively flat, grass covered terrain. Trees are not evident in this area except for limited growths along the Missouri River and smaller creeks.

There are no ordinances governing the types of refuse storage containers required or the methods of storage to be used at Ulm. At one time there was private collection here but it was discontinued because of a road hauling technicality. Now disposal is left up to the individual homeowner. Information from the City-County Health Department's environmental sanitation survey indicates that 89 per cent of the residential and business areas have inadequate refuse containers and 36 per cent have rubble on the premises. Seventy-one per cent of the services practice burning on their premises. There is an open dump site located 1/2 mile north of Ulm and adjacent to the Ulm road. The site is owned by the Ulm Volunteer Fire Department and covers 0.8 acres of relatively flat terrain. Limited space will prevent usage of this site much longer. Adjacent to one side of the area is a small creek which flows only during the spring runoff period but could become polluted from the refuse in the area Refuse is spread all over the small area and encroaches very close to the graveled Ulm road making the unsightly area noticeable to every passing motorist. The site is open throughout the year. A sign along the road indicates what can be dumped in the area. Unauthorized dumping is occurring at times across the road and at some other places around Ulm. Barbed wire fencing around the site allows blowing papers to spread across the road and into the surrounding fields. Insects are not controlled in the summer and are prevalent throughout the area. During warm weather a fire could spread to the surrounding grass covered land due to the accumulation of burnable refuse in the enclosure. It is impossible to prevent people from burning refuse at the site when there is no one there to take charge of the area.

The junk cars in and around Ulm number approximately 51 including those dumped along the river banks.



ULM
DUMP
SITE

VAUGHN

Vaughn, located on U. S. Highway 89 in the northwest area of the county, has a population of 335. This farming community has no collection service and the individual landowner is left with the responsibility of disposing of his own waste material. The City-County Health Department's environmental sanitation survey indicated that 91 per cent of the premises in Vaughn had inadequate refuse containers and 70 per cent of the premises had rubble on them. Some backyard burning is done to reduce the volume of waste for disposal. The disposal site is a small open dump of 0.5 acres, located 0.3 of a mile north of Vaughn adjacent to the county road. The site is owned by Bruce Nelson and maintained by the county. Immediately adjacent to the road the site is relatively flat with the terrain dropping off towards the back of the area. As the refuse becomes piled up along the road it is dozed back into the lower portion of the site. The county road is paved to the site and the road into the area is very short making the site accessible all year around. There is no limit on hours of dumping and there is a sign specifying the area as a dump site. Refuse is not segregated into types for dumping in specified areas but is all mixed together including car bodies, dead animals and other bulky refuse. Woven wire fencing exists around part of the area although refuse has been piled against the fence until the fence has collapsed. Blowing papers are a problem due to the lack of a wind barrier. Dumping occurs outside of the fencing as well as at other places around Vaughn. Flies and other insects are prevalent in the area during the summer although no rats have been sighted. Even if this small disposal area wasn't filled almost to capacity, the type of terrain here would not be suitable for conversion to a sanitary landfill type of operation. The existing material should be compacted and buried when a new site is obtained for a sanitary landfill. Water pollution is not likely due to the location of the site in relation to the streams nearby.

Old car bodies are disposed of on the open prairie around Vaughn and 135 total hulks were counted. Only 20 of these were around private homes in Vaughn and the remainder were along creeks and piled up on the prairie.

VAUGHN DUMP SITE

INDUSTRIAL REFUSE

Industrial refuse consists of solid waste materials from factories, processing plants and other manufacturing enterprises. The collection of this waste is rarely regarded as the responsibility of the city but as an obligation of the industry. Refuse falling into this category would be putrescible garbage from food processing plants and slaughter-houses, condemned foods, building rubbish and manufacturing refuse.

Since putrescible industrial refuse may cause problems and even endanger public health, the storage, collection and disposal of it is subject to local governmental control. Most of the larger industries are handling and disposing of their industrial wastes in accordance with local regulations.

The Anaconda Company is the number one manufacturer in Cascade County in terms of both employees and payroll. The majority of their solid waste material for disposal is paper and trash and they handle it themselves. All of the metal products are returned to the furnaces.

Meat packing plants have to dispose of a large amount of waste or by-products of the meat packing process. Instead of disposing of the material, the majority of it is put through a rendering process which produces tallow and grease for use in the manufacture of soap and livestock feed, meat scraps for livestock feed, hog hair for insulation material and stuffing for furniture, hides for leather products and blood for manufacturers of adhesives and livestock feed. Rendering plants at meat packing facilities eliminate the disposal problems at the plant and also help to eliminate the county-wide disposal problem. In addition to their own by-products, dead livestock from stockyards, farms and ranches and inedible items from other meat packing plants, meat markets, restaurants, etc. are rendered at these plants. When rendering plants are not available for the disposal of dead livestock, many carcasses are left unburied around farms and ranches.

As a result these carcasses decompose and are a health hazard. During the winter months in Montana the frost reaches depths of 6 or 7 feet. The ground thaws very slowly in the spring even though the air temperature is well above freezing. Any carcasses lying out in the open are subject to warm temperatures a long time before the ground is thawed enough to easily dig a hole for burying Even though the frozen ground is difficult to excavate, it is essential that provisions be made for promptly disposing of the carcasses during the winter months.

In Great Falls there are two rendering plants to which livestock owners can haul their animal carcasses and sell for a small amount. It is not economical for the rendering plant to pick up the carcasses, but they do pay a nominal fee for the carcass at the plant, provided it has not decayed to any extent. If an animal has started to decay, it becomes a solid waste problem and should be promptly buried. It is often difficult to locate the owner of the animal and get him to bury the decaying carcass.

A problem has occurred at the meat packing plants when the rendering plant was overloaded and the excess material was wasted outside in open dumps. This type of disposal results in a very unsanitary condition, forming a breeding place for insects and rodents. The City-County Health Department is working with the plants in an effort to eliminate this problem.

The hospitals in Cascade County are all located in Great Falls. Each hospital has its own garbage disposal units for grinding garbage and wasting it to the sanitary sewer system. Gas fired incinerators are also installed at each hospital for destroying waste material. Waste that is not contaminated and non-combustible is disposed of at the Great Falls sanitary landfill.

Malmstrom Air Force Base located near Great Falls has its own disposal facilities. It has its own collection trucks and disposes of the waste at an open dump site on the base grounds. Bulk containers are used for storage of the refuse at the pickup points.

Great Falls International Airport collects and hauls its own refuse from the airport and restaurant to the Great Falls sanitary landfill.

A brewery located in Great Falls sells its malt waste to the local dairies for use as livestock feed. The remainder of its waste is collected by the City of Great Falls and disposed of at the city landfill.

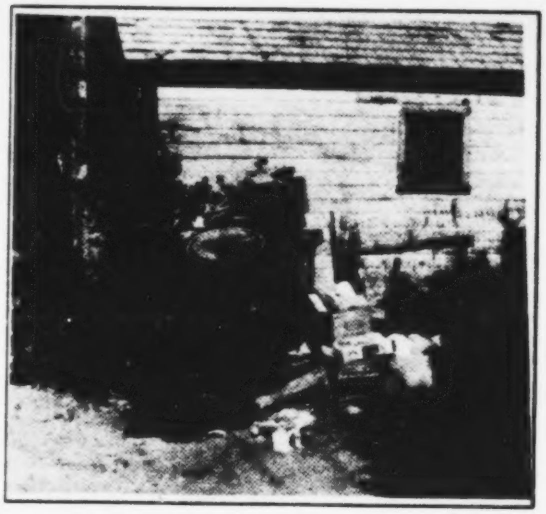
The feed lots and dairies in the county generally dispose of any dead livestock either by selling the carcass to a rendering plant or by burying it. Manure from the livestock creates some problems in the spring due to accumulations in the animal pens. However, in the spring the pens are cleaned and the waste is usually spread over large fields for drying to help prevent fly production. Some odors do persist in these areas. The location of feed lots or stock pens near any river and particularly near any running water should be considered a source of water pollution. Many other solid wastes produced by the feed lots and dairies are disposed of at the Great Falls sanitary landfill or on the owner's property at his disposal site.

Other industries in Great Falls usually have indoor incinerators for reducing the volume of their refuse. In addition to this they utilize the Great Falls

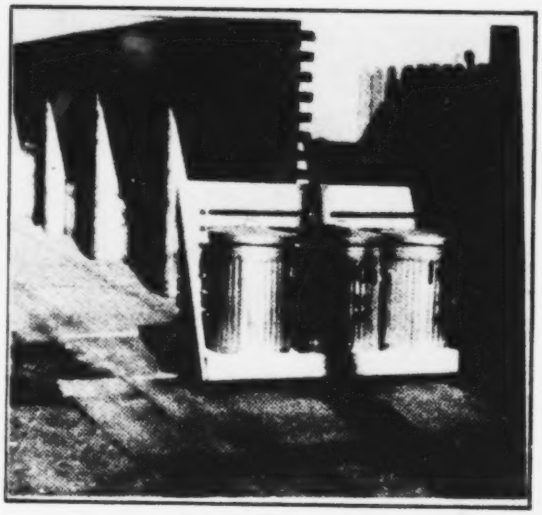
City collection service for disposal of the remainder of their refuse. The industrial waste material that would cause problems at the sanitary landfill usually does not reach the landfill site. It is disposed of by the producer although his methods of disposal may not be satisfactory according to health standards.

SECTION IV - STANDARD METHODS OF STORING REFUSE

The appearance of a city, town or community depends a great deal on the storage of solid wastes. Good storage techniques are extremely important for health and sanitation reasons to prevent vectors from breeding around the storage sites. Offensive odors develop in areas of improper storage. Efficient collection service depends on uniform and adequate storage facilities. If refuse is spread all over the storage area and stored in all types of containers, the collection procedure will not be efficient and the homeowner will pay more for the service. Better health and better economy are obtained through good refuse storage practices.



IMPROPER REFUSE STORAGE



PROPER REFUSE STORAGE

The responsibility for storage is borne by the individual homeowner. Guidelines and ordinances are usually set up by the collector, whether it be the city, town or a private contractor, and anyone not conforming to the regulations will not have his refuse collected. If the homeowner allows the refuse to accumulate in an unorderly manner, it is declared a misdemeanor and the homeowner is subject to prosecution.

REFUSE STORAGE CONTAINERS

In establishing standards on refuse storage containers for residential districts there are several factors which must be considered. The size of the container should be limited to 20 - 32 gallons to allow for easy mobility. A durable galvanized container tapered for ease of emptying should be required for all services. Large barrels of 50 - 55 gallon capacity are easily obtained from industry and many homeowners use these for refuse storage. Some collectors allow the use of these large cumbersome containers providing they are covered with fly-tight lids and do not weigh more than a given amount when filled with refuse. Two collection employees are normally required to handle these containers. A container should be constructed in such a manner that it can be easily cleaned.

Storage containers are now available in either plastic, metal or paper. Disposable containers are being used by some municipalities. They consist of wet strength kraft paper or plastic bags of various capacities from 20 - 30 gallons. Several types of metal bag holders are available for securing these bags in place and for covering the bag with a metal lid. The kraft paper bags have one advantage over the plastic bags when disposed of at a sanitary landfill. The kraft paper will decompose and allow the refuse to decompose whereas the plastic will prevent the refuse from decomposing for many years.

Another factor to consider in establishing container standards is the requirement of a fly-tight lid for exclusion of insects and rodents, for protection from the weather, and for prevention of scattering papers.

LOCATION OF CONTAINERS

Refuse containers when not set out for pickup are usually placed in one of 4 places: (1) in an attached garage or basement, (2) at the rear or side of the house, (3) at the rear of the property by the alley, and (4) in recessed containers at the curb site.

The most convenient container location for the collectors is at the rear of the property by the alley. This location is not as convenient for the home-owner and this container isolation often results in littered storage areas and makeshift containers.

In areas where alleys are non-existent, recessed storage containers are often located in front of the homes by the street. On the scheduled day of pickup excess refuse is piled on the ground in front of the homes detracting from the general appearance of the area. During the cold winter months recessed containers often become frozen in the hole and require heat to thaw them out. One advantage of this curb side container location is that the storage area is usually kept clean during that part of the week after collection is completed.

RECESSED STORAGE

LOCAL CUSTOMS AND ECONOMIC LEVELS

Other factors that affect storage practices are the local customs and the economic levels of the district. Many people tend to conform to the practices of their neighborhood. If all the neighbors maintain a clean storage area for refuse containers, a homeowner will usually try to conform to the same practice. The lower economic levels usually have less refuse although their storage facilities are often inadequate in spite of the smaller storage containers required. The upper economic levels usually have more refuse to dispose of and generally they can afford to buy sanitary refuse containers for storage. However, economic level does not always indicate the type of storage area condition that will prevail in a certain district.

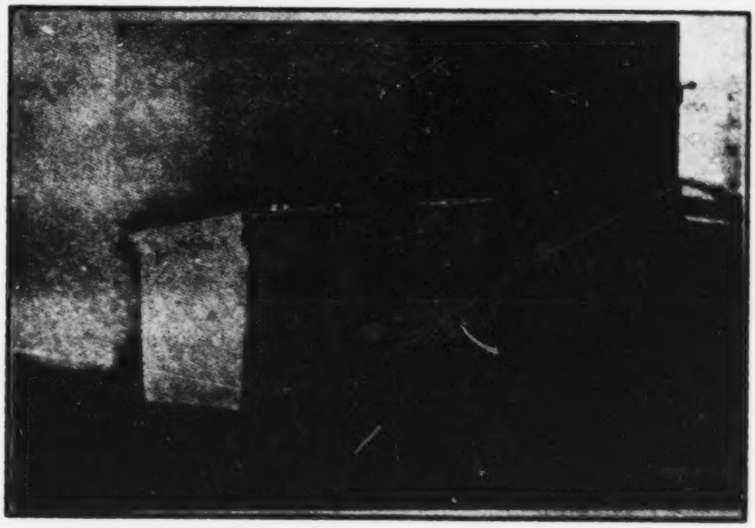
INDUSTRIAL RESPONSIBILITIES

The storage of refuse at commercial and industrial operations is the responsibility of the firms and the local government. The nature and quantity of the refuse produced may be a unique type requiring special handling and disposal. When a commercial or industrial firm disposes of its own refuse, the storage containers are usually designed in accordance with the type of collection vehicle or the hauling vehicle that is used and also the type of waste that is discarded. The storage containers set out for city collection vehicles must meet the requirements of the city. Many commercial and industrial firms dispose of their own industrial waste and use city collection service for disposal of refuse such as waste paper.

CONTAINERS FOR INDUSTRIAL WASTE

Containers for refuse storage of industrial waste are of a shape, volume and construction to meet the particular needs of the nature and volume of waste produced.

Detachable containers are available from 1/2 cubic yard to 40 cubic yard capacities with facilities for end loading or top loading. The smaller size bulk containers can be emptied into mechanical packer collection vehicles that are used for regular refuse collection. A container lift system picks up the bulk container and empties it into an opening in the top of the packer truck or into the opening in the back of the truck where the household waste is dumped. Fully enclosed water-tight bulk containers are available in most sizes up to 16 cubic yard capacities. The bulk containers from 16 cubic yards to 40 cubic yards are normally open on top and can be covered with canvas when en route to the disposal site.



BULK CONTAINERS FOR REFUSE STORAGE

STATIONARY COMPACTOR UNITS

Stationary compactor units are bulk containers equipped with a mechanical packing device for compressing the refuse into a smaller space. These compactor units are for individual commercial firms or industrial firm that have a large amount of waste material. By compressing the refuse in the container, the hauler can make fewer trips to the disposal area and haul more refuse. Stationary compactor units are stored on platforms or on the ground and when filled to capacity, they are winched or hoisted on to a specially designed flat bed truck for hauling. Stationary compactor units are generally used by commercial and industrial firms and not by local government collection systems.

SECTION V - ON-SITE DISPOSAL OF SOLID WASTES'

On-site disposal is not a method of final disposal of refuse but only a means of reducing the volume of the material before final disposal. Any factory, restaurant, institution, multiple-dwelling unit or private home that reduces the volume of the solid wastes before having it collected for final disposal is doing so by one of the methods of on-site disposal. There are several types of volume reduction or on-site disposal: mechanical compaction, incineration, pulping, and composting. For health and economic reasons on-site volume reduction is beneficial. Elimination or reduction of food wastes helps prevent production of flies, mosquitoes and rats. Storage areas are generally kept neater when smaller quantities of refuse are stored. Also, with smaller amounts of refuse there is less handling and correspondingly lower labor costs for pickup and final disposal.

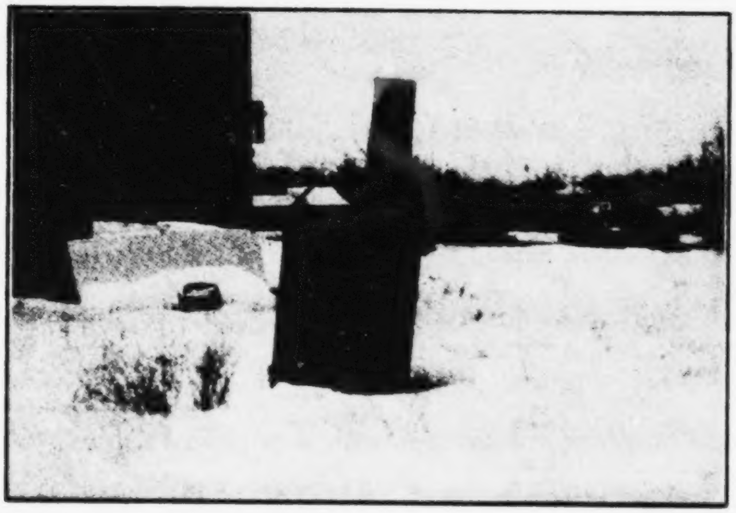
MECHANICAL COMPACTION

Mechanical compaction of refuse is a method by which the refuse is compressed into a smaller volume and then stored in a bulk container for pickup at a later date. This method decreases the volume of the material and requires fewer haul trips to the final disposal site.

BACKYARD BURNING

Another method of refuse volume reduction is backyard burning on the ground, in wire mesh containers, in barrels or in outdoor fireplaces. The advantages here are the same as for any type of on-site disposal method in that the volume of the refuse is reduced for subsequent collection and disposal. However, the disadvantages of this method of home disposal will probably eventually cause it to be prohibited in most states. Air pollution is the primary drawback of open burning and it results from low burning temperatures and incomplete combustion. Garbage and wet papers do not incinerate completely and after cooling, could attract vermin to the container. Odors also become offensive around the cans. After the refuse is burned, the residue is usually set out for pickup by the city or private collection service. The smoldering ashes in the refuse container can create a fire hazard. Collection vehicles are especially susceptible to fire because of the flammable nature of the refuse they carry.

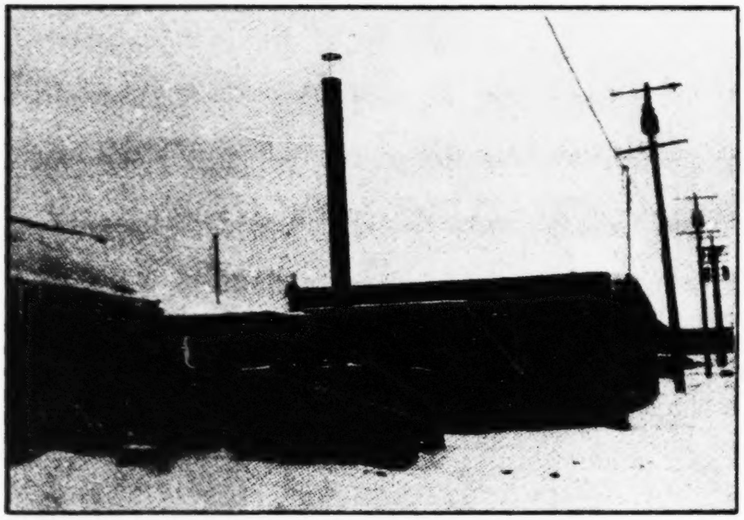
Backyard burning has been practiced throughout the United States for many years until recently when municipalities realized the amount of air pollution caused by the burners. Multiple units and commercial establishments often use burners to reduce the volume of waste for disposal.



BACKYARD BURNER

INCINERATION

Incinerators, without auxiliary fuel supplies, are less satisfactory than outdoor backyard burners as far as air pollution is concerned. Fuel fired furnaces are of varied types and should be designed to suit the type of material to be burned and also to conform to the air pollution requirements. Gas fired incinerators are used extensively throughout the country by many commercial establishments. With the advent of more rigid controls on air pollution, incinerators that pollute the air will eventually be declared unsatisfactory as a means of disposal.



ON-SITE INCINERATOR

COMPOSTING

Composting is a method of making a soil conditioning material through the decomposition of refuse. This is a method of volume reduction or on-site disposal that is not practiced to any great degree in the United States. The refuse is stored on the ground or in buried containers and after a certain period of time decomposes and forms a soil conditioner. The refuse does not decompose very effectively when piled on top of the ground unless the refuse was originally ground up or shredded into smaller pieces. Open piles of refuse are obvious health hazards, being sources for breeding insects and rodents such as flies and rats. If the refuse is placed in bottomless cans with tight fitting lids, the food wastes shrink and decompose to about 1/4 of their original volume. Composting is practiced more in the rural areas than in the urban areas. It is a slow process and would not reduce the yearly volume of refuse to any great degree. Composting as a type of on-site disposal or volume reduction of refuse is not recommended due to the unsanitary conditions that usually develop during the process and the inefficiency of the lengthy period of decomposition. Composting would be used more on farms or for individual homes than it would be for a method of volume reduction by a commercial establishment.

PULPING

Another method of refuse volume reduction that is used for multiple-family units, hospitals, and office buildings, is pulping. This is a process in which paper wastes are ground up in a water vortex and then squeezed semi-dry. Originally this process was designed for elimination of secret documents at banks. It is a fast method and reduces the volume of paper by up to 80 per cent. Chute disposals reduce the amount of handling required. The waste travels down the chute and into the pulping equipment and eliminates any additional carryout handling. The equipment is expensive when initially installed and since it does use water in the grinding process, the water consumption in the building will increase some after the equipment is put into use. Chutes used to carry the refuse from the rooms to the pulping equipment may plug up and require periodic cleaning. After the paper waste is pulped it is collected by the city or private collection service and hauled to the final disposal site. If final disposal consists of municipal incineration, problems could develop due to the wetness of the pulped paper causing incomplete combustion during incineration. The reduction of the refuse by pulping would be an advantage if final disposal consisted of burying at a sanitary landfill. This compacted paper waste would require less space than collected refuse compacted in a mechanical packer, and would increase the life of the sanitary landfill. Pulping is a relatively new process in the United States and is being used in areas where incinerators are being legislated out.

COMPACTION

Compaction of refuse on a small scale is also being used for volume reduction for multiple-family units, hospitals and office buildings. This is a method of compressing the refuse into paper sacks or containers for disposal. This is similar to the large mechanical compactors previously mentioned, although this method is on a smaller scale and the compacted refuse is packaged in bags here. The high compaction ratio reduces the volume up to 75 per cent. Small refuse compactors with subsequent packaging of the compacted material eliminates the need for rubbish barrels and for on-site incineration. Usually city or private collection service is used to dispose of the packaged refuse material. The bags or containers are so heavy, even though they are not large, that special facilities for loading the compacted refuse containers on the collection trucks are required. Compactor units such as these are being used in Europe and recently have been installed at some locations in the United States. They are of value in areas where on-site incineration has been prohibited.

Because of the solid waste disposal problems that have developed in the United States due to the scarcity of land for sanitary landfills and the new air pollution laws, volume reduction or on-site disposal of refuse may become more prevalent. New methods of volume reduction of waste will probably develop in the future and should help to eliminate some of the problems.

SECTION VI - STANDARD METHODS OF REFUSE COLLECTION

COLLECTION

The collection of refuse is a very important phase of the total operation of solid waste disposal. The collection operation is the act of transferring refuse from the householder's premises to the collection vehicle. Approximately 70 - 85 per cent of the total cost of pickup and disposal of refuse is spent on the collection phase of the service. Collection of refuse is therefore very important from an economic standpoint.

METHODS OF COLLECTION

Collection of refuse can be performed by any of 3 different methods or any combination of the 3. They are: (1) public (usually municipal) collection, (2) contract collection, and (3) private collection.

Public Collection

Public collection is performed by public employees and equipment. The municipality has the responsibility of collection of refuse. Because of public pressure the collection service cost is often kept at a minimum and the resulting service rendered is not adequate from a health or esthetic standpoint. However, one of the main advantages in having a public agency collect the refuse is that the public agency will usually furnish the type of service the public wants and pays for, whereas, private collectors are sometimes difficult to work with.

Contract Collection

Contract collection is performed by a private collection firm paid by the municipality with money collected by the city from the homeowners. The municipality enforces ordinances pertaining to the homeowner as well as to the collector. The contractor operates this pickup service as a business and his help has to be skilled enough to allow him to earn a profit. Any of his employees who do not work efficiently are of course replaced. Results are a more efficient collection service unhampered by political interference. Normally the collection equipment is owned, operated, and maintained by the contractor and the city has nothing to do with the equipment as long as it conforms to the ordinances. However, some municipalities are experimenting with furnishing the equipment and contracting for the labor force to do the collecting. Equipment maintenance problems could develop under a system such as this.

There are some disadvantages to a contract collection type of system. With a contract service the cost of the pickup is determined in advance of signing the contract agreement, which results in less flexibility of the service. There is also the possibility that if for some unforeseen reason the contract is broken, there would be no alternate means available to continue the collection service. Collection equipment costs represent considerable investment and could not be justified for short term use, thereby requiring a reasonable-length contract. Careful development of the contract document will protect the community and allow the contractor to provide the service desired.

Private Collection

Private collection is performed by an individual or a company who makes its own arrangements with the private homeowners for providing the service and collecting fees. The private collector may be required to conform to the city ordinances controlling the type of equipment used and the methods of collection. However, public officials have a minimum of control over this type of collection service. In many instances, without the private collector there would be no collection service available.

No matter which type of collection service is used, it is important that some governmental agency takes the responsibility to insure the public that the service is adequate.

FACTORS AFFECTING COLLECTION METHODS

The proper design and operation of a collection system depends on many factors which are all interrelated. These factors must be considered before a satisfactory program can be set up for collection of refuse. The major factors to be considered are listed below.

Population of Area

From a public health standpoint, the need for refuse collection is directly related to the population density. The refuse of an isolated rancher cannot be considered a public health hazard whereas the proper storage and collection of refuse in populated areas is essential.

It is not economical to organize a collection service for a sparsely populated area due to the travel distance between pickups. However, communities in which the pickups are all located in one general area, are usually economically able to support a collection service. A study made by the University of California indicates that a pickup density between 25 and 175 services per mile has relatively little effect (± 5 per cent) on the pickup time. A collection route of 175 services or dwelling units per mile would be similar to a populated area in a metropolitan district. When there are less than 25 dwelling units per linear mile, the man-minutes required to pick up each ton of refuse increases to such a degree that it is not economical. When the rural areas become populated to the point of having a minimum of 25 services or dwelling units per mile, the costs for collection in that immediate area should be comparable to the costs for a more populated area. It should be mentioned here that it would not be economical to organize a collection system to serve only 25 dwelling units located in a remote area. The initial cost of the equipment and operating costs would be too high. The minimum of 25 services per mile mentioned above would apply only to the fringe areas around a city or the populated area of a smaller community. The 25 services per mile indicates a density only and the population of the collection area would have to be considerably more to make it feasible to organize a collection service for the area.

Topography

The topography of an area can affect the collection service in 2 different ways. Collection vehicles are usually large and weigh a considerable amount when loaded to capacity. Even when empty, these large trucks with their lower gear ratios, require more travel time and cost more to operate in hilly areas or on long grades as compared to flat areas. Where collection routes are located in hilly districts the refuse trucks should proceed first to the highest portion of the collection route and work downhill. The starting and stopping action of a large vehicle on uphill grades is costly due to fuel consumption and wear on the clutch, brakes and other mechanical equipment. Savings result from operating downhill where possible.

In areas where homes are located on sidehills and refuse collection employees are required to carry refuse containers up and down steps, the pickup time will increase over that required on flat terrain.

Physical Layout of Area

The physical layout of an area determines the routes that will be used for collection of refuse. Homeowners living in areas that are subdivided without alleys have to set their refuse containers by the street for pickup. Alleys are usually wide enough for easy access with a collection vehicle and refuse containers are conveniently located along the edges of the alleys. For street pickup, the trucks usually have to travel over each street twice picking up containers on one side at a time. On residential streets that aren't congested with traffic, the collectors may pick up the containers on both sides of the street while making only one pass down the street with the truck but there is always the danger of a pedestrian-car accident. Generally, street pickup is more hazardous, more time consuming, and therefore more costly than alley collection.

Collection routes should be laid out in such a manner that travel to and from the collection area is done on uncongested streets. The loading operation should begin in the less accessible areas or in the residential areas and progress toward the thru streets or highways that are to be used for travel to the disposal site. Thru streets and highways carrying heavy traffic loads should be avoided. By starting the loading operation at the far end of a route and working toward a well traveled road or highway, considerable time can be saved in travel to the disposal site. The truck is filled to capacity when it reaches the highway and time is not wasted maneuvering a heavily loaded truck through a residential area.

Type of Refuse Produced

The economic level of residents may vary from one community to another, and this often affects the quantity and quality of the refuse set out for collection. Varying economic levels may impose certain demands on the collection agency with respect to the frequency of the collection and the location of the refuse container.

Garbage grinders are becoming more popular and they have a definite effect on the type of waste set out for collection. If a sink garbage grinder is used, the garbage is carried through the sanitary sewer system to the sewage disposal site. Refuse obtained from a district using garbage grinders consists primarily of combustible paper waste without any putrescible matter. Garbage grinders are practically non-existent in rural areas or communities that use septic tanks for sewage disposal.

Climate

Climatic conditions vary from one area to another and should be considered in determining the frequency of collection. During warm periods garbage will rot much faster than on cool days. The rate of decomposition of putrescible refuse is a function of the temperature and the humidity of the area where the refuse is stored. Twice a week collection during the summer as opposed to once a week may be necessary to prevent the stored refuse from becoming objectionable.

Different seasons of the year affect the amounts of refuse set out for collection. During the spring when homeowners clean up their yards, collectors are subjected to an increase in tree and yard trimmings and other rubbish. This increase may require an extra pickup per week or special trucks to handle the different types of waste if it is picked up by the regular collection service. Most city ordinances place limits on the types of material collected. During the fall months when the trees are dropping leaves, the collection crew will again be faced with an increase in waste. Special suction equipment, along with added weekly routes, may be required to pick up and dispose of the leaves during the peak periods.

Weather extremes will affect collection vehicles and crew efficiencies to a certain degree. Frozen lids, cans and garbage are difficult to handle. Heavy snowfalls can limit access to disposal sites and through alleys.

Zoning

Commercial areas will produce a different type of refuse than residential areas. Downtown business districts dispose of a large amount of paper and combustible waste. Restaurants contribute some putrescible matter to the waste. Industrial areas may produce many varied types of waste, some of which may require special handling by the collector. Material that has to be handled in a special manner is usually not collected by the regular collection service but is the responsibility of the industry producing the waste. The zoning of an area, whether it be residential, commercial, industrial, or agricultural, will have a definite effect on the type of waste produced there.

Storage

Storage practices will affect the method of collection required for an area. Two men will be required for lifting and dumping large 50 - 55 gallon storage barrels. The smaller 32 gallon tapered galvanized can, if not overloaded, can be easily handled by one collector.

Refuse containers are stored in back of residences near the alley, alongside of houses or out in front of the houses near the street. Different locations for refuse storage require different methods of pickup and different size crews. Crew size will be discussed more in detail in another portion of this study.

Some municipalities have separate pickup service for garbage (putrescible waste) and other waste. The garbage is usually sold to farmers for feeding to hogs and the other waste is discarded at the disposal site. This causes some confusion for the collection agency because many homeowners do not wish to be bothered with separating the garbage from the remaining waste.

Frequency of Collection

Field studies made by the University of California and Northwestern University indicated that twice per week collection generally results in considerably greater quantities of refuse being collected from each service per week than once per week collection. The frequency of the pickup service does affect the amount of refuse produced and collected. The more frequent the collection the greater the amount of refuse collected per service or per capita. It appears that families are making broader use of refuse service when it is on a twice weekly basis.

Twice per week collection may be desirable to prevent vector from hatching and garbage from rotting. In some cases the size of a satisfactory refuse container may determine the frequency of the refuse collection. Excessive accumulation of refuse at the household should be avoided as it invariably encourages inferior sanitation practices. Also an excess number of small storage containers slows down the normal loading operation.

Time studies of the effect of collection frequency on labor requirements of the pickup operation indicate that twice per week collection requires approximately 1.55 times as much manpower per ton of collected refuse as once per week collection, assuming the same total amount of refuse is collected from each service each week regardless of the frequency of collection. However, the total amount collected increases when the pickup frequency increases and this would further increase the manpower required.

Collection Equipment Used

Collection methods are directly related to the type of equipment used. The pros and cons of the various types of available collection equipment are discussed later in this section.

CREW ORGANIZATION

Collection crew organization is directly related to the overall efficiency of the collection system. Incentive programs are used by many collection agencies to obtain faster and more efficient work from the collectors. These incentive programs, which allow the collector to leave work for the day following completion of a pre-set route, often result in a more efficient collection system than the required 8 hour per day system.

Daily Route

The daily route method of crew organization is one type of incentive system for a collection route. The crew is assigned to collect the refuse from a different pre-set area each day. Following completion of this daily pre-set route, the collector may leave even though he has not worked the full 8 hours. However, should he work overtime because of an above normal amount of discarded refuse, he will not be paid overtime. This daily route method usually is set up so that the average hours worked are less than 8 per day. Each worker is paid for 8 hours per day. If a collector knows he has to work an 8 hour day he will probably space his work accordingly, showing little ambition. However, if he realizes that he can leave work upon completion of his work route, he will normally work faster and harder in hopes of finishing his work early. The amount of services that a crew will pick up on the incentive program will normally be more than the amount a crew on a regular 8 hour shift will collect.

Weekly Route

Another type of incentive program consists of setting up a route on a weekly basis. There are no pre-determined stopping places each day and when the crew is finished with the weekly route it is through for the week even though it didn't work the normal 40 hours. On this type of route the homeowner does not know when his refuse will be collected, and this type of incentive program could not be used where the homeowner is required to set out his container at the curb.

Definite Working Day

When a crew is required to work 8 hours a day, the daily routes are sometimes pre-set and upon.completion of the route the truck crew must wait until quitting time before leaving. Under this system the routes are usually set up to keep the crews busy 8 hours a day during the high collection periods. During the seasons when the refuse production decreases, the men complete their routes early, but are required to stay until quitting time.

Irregular Frequency

Routes are sometimes set by the week and collectors are still required to work 8 hours per day. The crew, after working 8 hours, is through for the day no matter where they are at quitting time. Homeowners have no idea when their refuse will be collected under this type of system. They know only that it will be collected on an average of once or twice per week. After the crew finishes the pre-determined weekly route, it immediately starts all over again even if it didn't require the whole week to complete the route. Collectors continually work the same route over and over again and their speed is determined in part by the refuse quantities produced in that area. There are no set days for certain pickups. This is not an incentive type program.

Conclusions

The disadvantage in the incentive type program is that it is difficult to determine the length of the collection route that will give the maximum work from the collectors. However, once the route is determined the pickup time will not vary to any degree. The system appears to work well where it is being used. The primary disadvantage of the 8 hour required working day system is that there is a lack of incentive on the part of the collector. When the collectors are finished with their fixed daily route they are required to wait around until quitting time. Collection crews standing idle while waiting for quitting time are prime subjects for unfavorable criticism by taxpayers.

Schedules are also affected by holidays. When a collection crew works on a holiday it should be paid double the normal hourly rate. If they do not work the holiday they must work on Saturday to bring their pre-set route back on schedule. In a situation such as that they should receive 1-1/2 times their normal hourly rate for the actual amount of Saturday work done with a maximum of 8 hours overtime paid. Since they do not work the holiday they receive regular pay for the holiday if it falls during their regular work week.

COLLECTION EQUIPMENT

Vehicles used for refuse collection should be sanitary, reliable, easy to load and unload, and safe for the workmen. A pleasing appearance is also desirable. The dimensions of the vehicle should be limited to allow for easy maneuverability through alleys and streets. The capacities of the vehicles will depend on the frequency and methods of collection, length of the haul to the disposal site, and the width of alleys and streets. Other details to be considered are loading heights, covers, loading and unloading devices, motive power, speed of travel, water tightness, and legal payload.

Collection vehicles are usually classified according to the type of truck body incorporated on the unit. Generally there are three different types of units employed by municipal refuse collection which are: (1) open-body trucks, (2) enclosed or covered body trucks, and (3) packer or mechanical compaction trucks (also enclosed body).

Open Body Vehicles

In operating the open type refuse truck it is often hard to control insects and blowing papers. Due to the height of the sideboards on these vehicles, they are usually equipped with retractible running boards or stair steps for the collector to stand on while emptying containers. Some trucks are also equipped with hinged sideboards to lower the loading height of the vehicle when partially full. Other trucks have hydraulically actuated buckets that lower to ground level for ease of loading and then lift the refuse over the elevated sideboards. One esthetic disadvantage to open body trucks is the exposure of the refuse during the loading operation. Tarpaulin covers are usually used to contain the refuse during the haul to the disposal site. Overloading practices on open type vehicles often cause scattering of refuse throughout communities and in any event are not generally justified from a labor utilization standpoint. Open trucks used for refuse collection normally have a dump type box for easy unloading at the disposal site. The most practical application of an open type vehicle is for use in collecting bulky waste items including yard rubbish and tree trimmings. Some industrial wastes are easily handled in these vehicles also.

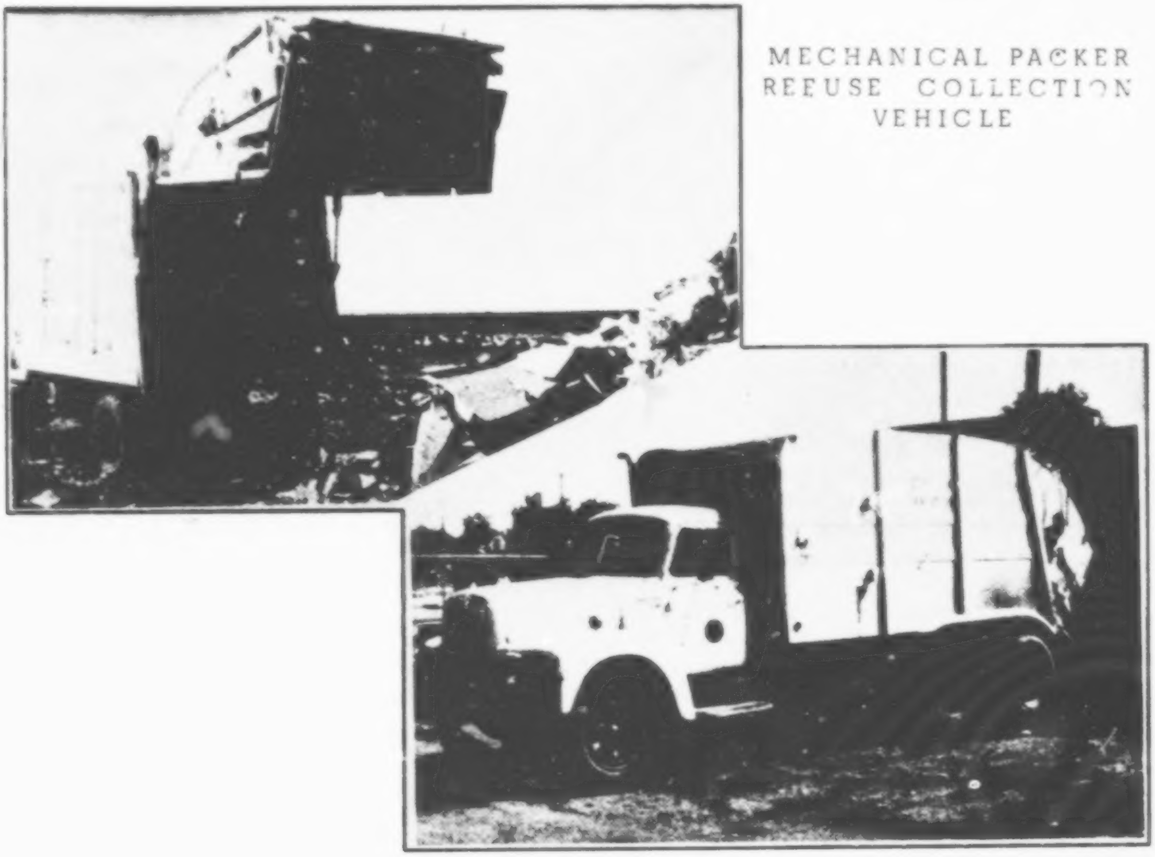
Enclosed or Covered Body Vehicles

Covered body vehicles are usually equipped with sliding steel sectional covers throughout the length of the truck. Running boards or ladders are often available for easy access to the truck bed for dumping refuse containers. Enclosed vehicles have fewer insect and blowing paper problems than open type vehicles. They are also more pleasing to the eye because the refuse is not exposed. Large doors at the rear of the unit open the entire end of the bed and provide an unrestricted area for easy dumping. This type of body tilts up for normal dumping operation. A well designed covered-body truck often fills an appreciable need for an economical, sanitary, refuse collection vehicle.

Mechanical Compaction Trucks

Trucks equipped with mechanical compaction units for collection of refuse are becoming very popular. These units have greater capacities than open type trucks because of the compaction capabilities of the mechanical apparatus. Compaction of the refuse is usually accomplished by one or two different types of mechanical equipment. One type has a rear retaining panel that holds the refuse inside the body. When the loose refuse fills the empty space in the packing area, a rear compacting panel packs the refuse into the truck. This type of packing mechanism does not pack the refuse in the forward part of the unit as well as it does in the rear part near the packer mechanism. Units such as this usually have dump bodies that tilt upward for discarding the refuse.

Another type of packing mechanism has an ejection plate which is utilized in conjunction with the rear packing mechanism. When the truck is empty the vertical ejection plate is located near the rear of the truck and close to the rear packing mechanism. The refuse is continually compressed against the vertical plate until enough pressure is reached to shove the ejector plate toward the front of the packing space. As more refuse is shoved forward and compacted against the plate, the vertical plate is pushed ahead of the refuse. This vertical plate gives a more uniformly compacted mass because the refuse is compacted throughout the complete loading operation.



MECHANICAL PACKER
REFUSE COLLECTION
VEHICLE

Mechanical compaction bodies are available in many different types with capacities ranging from 10 to 40 cubic yards. One of the principal advantages of this type of collection vehicle is the low loading height of the refuse hopper in the rear of the vehicle. The bodies are covered, leakproof, and built to withstand corrosion and abrasion under normal use. Design of the bodies allows for easy cleanability and gives a respectable appearance. A general disadvantage to all packer type collection vehicles is the additional noise created by the operation of the packing mechanism. The dead weight of mechanical packer type bodies is generally equal to or greater than the actual weight of the refuse carried. Because of the body weight, mechanical packers require heavier frames and chassis than do the open or covered body trucks of equivalent capacity. Proper crew conveniences such as safety devices, handholds, steps, mirrors, and turn and emergency stop signals are available for most mechanical packers. However, too often safety devices are eliminated to reduce initial costs and employee safety is sacrificed in order to save a few dollars of the taxpayers' money.

Refuse compaction will vary on different mechanical packer trucks. An average of 97 loads collected in 6 California towns gave an average compacted density of 440 pounds per cubic yard. The same study indicated the average weight of uncompacted refuse collected from 5 California towns in open body trucks had a density of 323 pounds per cubic yard. In summary, the mechanical packers were found to compress, on the average, 1.36 cubic yards of open truck type refuse to 1 packer yard of refuse. A check in Great Falls, Montana of five mechanical packer type trucks indicated they are capable of packing refuse to a density of approximately 420 pounds per cubic yard. Since the check on density was made during cold weather, we anticipated a somewhat higher density on a year-round basis.

The existing packers being used in Great Falls are several years old. The future compacted refuse volumes, as shown on pages 137-144, were based on 475 pounds per cubic yard. We felt that with new and improved packers, a higher density could be obtained in Great Falls.

CREW SIZE

The size of a collection crew that is most suitable for a given route depends on several variables.

Alley collections usually are accomplished by a driver and two loaders, whereas set-out, set-back service requires larger crews. These extra workers are required to carry the containers from the homeowners' premises to the street or alley for pickup and then return the empty containers to their original place of storage.

As the services become more spread out, in less densely populated areas, a large portion of the collection time is spent in travel. This would indicate that a smaller crew would be more economical where the travel distances are long and the quantities of refuse for collection are small. As previously mentioned, pickup time is not affected until the density of services drops below 25 per mile.

It is interesting to note that in the study made by the University of California there appeared to be no significant difference in the pickup time in man-minutes per ton between 2-man and 3-man collection crews; hence, no significant difference in the efficiency of the pickup operation. Nevertheless, a gross lack of efficiency may result from the use of 3-man crews, depending on the length of the haul operation and the number of collection trips per day. In order to obtain the same labor efficiency in the overall collection operation for a given haul distance, a 3-man crew must collect 1.5 times as much refuse as a 2-man unit.

When deciding on a crew size the question often arises as to whether the driver of the collection vehicle should also help load. The driver's time is more fully utilized if he does help load and it makes it possible to use only 2 men per truck. However, for safety reasons, it is not advisable for the driver to continuously leave the truck unattended at every stop. There may also be some conflicts with the union policies governing drivers. Usually the driver remains in the truck unless the collectors need assistance in lifting a large item or in carrying numerous containers.

TRANSFER

Following collection of refuse it is necessary to determine the most economical method of hauling the refuse to the disposal site. The obvious approach is to haul the refuse in the vehicle in which it was collected. However, if the haul distance is long, it is not economical to tie up collection crews and vehicles in highway travel and lengthy hauls. In a situation such as this, it may be necessary to use a large transfer vehicle, which is usually capable of carrying loads up to 60 cubic yards capacity. The smaller collection trucks transfer the refuse into the larger truck at a centralized point. The large vehicle then transports the refuse to the disposal site. In this system the expensive collection trucks are utilized for continuous pickup while the larger transfer vehicle does the hauling to the disposal site.

Large capacity transfer trucks are not the only modes of transportation being used to transport refuse. In some areas rail cars are being used to haul refuse away from populated areas. Large barges also have been used to transport waste. The added cost of transfer operations brings to attention the advantages of obtaining disposal sites for refuse before an area becomes congested and land costs go up.

RECORDS

Records pertaining to all phases of refuse collection and disposal are essential for providing data for future design of facilities. The general lack of records throughout the country has been one of the major setbacks in determining adequate methods for solid waste disposal. Detailed records should be kept on field data, equipment, accident, and administrative information.

Field data should include information concerning the collection phase of the solid wastes handling operation. Each collection truck route should be mapped and its schedule logged in a field book each day to indicate starting and stopping times of actual loading operations. Notes should be kept to indicate whether the type of refuse collected consists primarily of household waste, tree trimmings, grass cuttings, empty paper cartons, etc. Usually peak refuse production periods are indicated by the empty boxes and wrappings that appear at Christmas time and the tree and lawn trimmings that appear during the summer months. Each trip to the disposal site should be recorded. Probably the most useful information would be a record of the net weight of refuse disposed of at the site each trip. In determining the future requirements for a disposal site, the knowledge of weights and volumes of refuse produced by a certain area is an absolute necessity. See Table 12.

Equipment records are always important in any type of business; not only for determining the existing conditions of the equipment but also for indicating preventive maintenance required. Collection vehicles and heavy equipment used at the disposal site receive rough usage and eventually the maintenance costs reach a level where it is economically more feasible to purchase a new vehicle than to continue maintaining the old one. Without records it is difficult to determine when the added cost of maintenance reaches this unsatisfactory level. Operation expense data is also very helpful in determining total costs of a collection system.

To prevent accidents on any job, all the information concerning past accidents should be known. What were the causes of the accident; when did it happen; how could it have been prevented? Records of accidents are essential for insurance purposes and necessary for any court action that may develop. Whether the accident caused personal injury or property damage, complete records should be maintained. Refuse collectors have always had an extremely high injury frequency rate due to back ailments, hernias, skin diseases, crushed limbs and other ailments. A record of these injuries will help to determine when and where safety devices can be installed and whether different type equipment can be purchased to eliminate unnecessary accidents.

Administrative records are usually available concerning the dwelling units' services and the billing data. It is also helpful to keep records of any complaints made regarding the collection and disposal service. Personnel records are normally kept to indicate salaries, individual performance, length of employment and any additional training received. Personnel records are a necessity for any type of business and are of increased value as the employment figure becomes larger.

SECTION VII - STANDARD METHODS OF REFUSE DISPOSAL

There are several different methods of refuse disposal being practiced in the United States, including sanitary landfilling, central incineration, composting, feeding of food wastes to swine, and salvage and reclamation. The only satisfactory complete method of disposal of all types of refuse is the sanitary landfill method . All other types only reduce the volume of the refuse leaving a certain portion of refuse for further disposal.

SANITARY LANDFILL

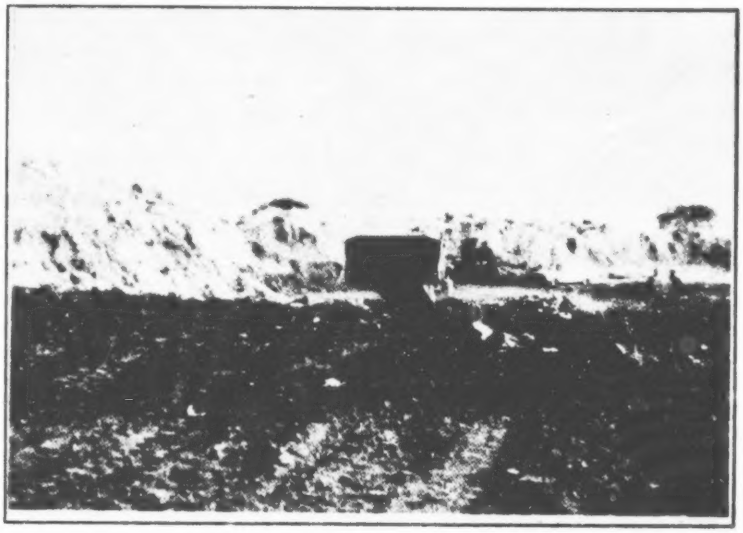
The sanitary landfill method of disposal involves depositing the refuse in a natural or man-made depression (area fill method) or trench (trench method), compacting the refuse in layers to the smallest practical volume, and daily covering it with compacted soil. Some areas are using coulees or even canyons for sanitary landfill sites. Each day the refuse is brought into the upper end of the coulee and compacted and buried. As the process continues, the refuse begins to fill the coulee with a series of cells of refuse separated by compacted soil layers. For public health reasons the compacted refuse is covered daily with a minimum of 6 inches of compacted soil. Before any operations can begin, a site must be selected and surveyed to determine the volume of space available for refuse disposal and hence, the future years' usage available there. In the area selected for the site there should be suitable cover soil available, preferably a sandy loam soil. Other soils can be used to cover the refuse as long as they can be well maintained and prevent the refuse from being exposed to the atmosphere. It may be necessary to haul the soil to the site from some other location if the existing soil is inadequate. Winter operations may require that soil be stockpiled for later use as cover material due to winter frost depths. Site preparation will include: building all-weather access roads, determining controlling grades of fill, and providing drainage around and through the area. The final step before operations can begin is to select the equipment needed to spread, compact and bury the refuse. Other provisions may have to be made depending on the climate and the site. Fences for controlling blowing papers, personnel facilities including washing units, signs for dumping directions, emergency fire fighting equipment, telephone units for emergency calls, and a means of watering down or controlling dust, are all facilities that should be considered before beginning operatión. For record data weigh scales have been installed at many landfill sites to determine the total amount of refuse received at the site daily. This also provides a convenient method for determining a dump charge for private collectors, who are charged by the weight and type of refuse dumped. Periodic topographic surveys of a landfill also indicate the rate at which an area is being filled.

The advantages of a well planned and operated sanitary landfill are: (1) it is economical; (2) it requires a relatively small capital investment; (3) it may reclaim land that is otherwise useless; and (4) it causes no air pollution.

There are also disadvantages: (1) it frequently requires longer and more costly hauls than other methods; (2) it requires more land than some other methods; and (3) operational problems may occur during inclement weather.

SANITARY LANDFILL
HAMILTON, OHIO

COVERING
COMPACTED REFUSE
AT LANDFILL
WAUKEGAN, ILL.



It is often difficult to obtain a site for a landfill until officials can demonstrate that it can be operated in a sanitary manner. Because of past inadequate operations, public resistance often dictates that a site be located a long distance from any populated area. Inadequate cover material may permit flies to emerge from eggs or larvae in the raw refuse. Even though the refuse is covered daily it may be necessary to institute some fly control measures around a sanitary landfill.

Fires may result in the interior of a landfill due to carelessness in operation. These fires are difficult to extinguish and may smolder for a long time adding to air pollution in the area. Fly problems and fires are public health and welfare aspects that require consideration. Another concern of public health officials, as well as water pollution control authorities, is the possibility of contaminating surface and ground waters through the use of sanitary landfills. Even though there is little evidence of pollution of ground water being caused by buried refuse under normal conditions, surface water pollution is possible at almost any sanitary landfill site if it is not operated properly.

With the steady increase in population throughout the country, land costs continue to climb. This is one of the reasons for the practice of reclaiming land. Land depressions are often filled with compacted refuse and once the areas are filled they are covered with 2 feet of cover soil. As the refuse decomposes the ground will subsequently tend to settle. It is therefore not feasible to construct buildings or structures on the fill but the filled land can be used for parks, golf courses, camping areas, parking lots, and farm land. These recreational and agricultural developments on reclaimed land are proving to be very satisfactory in many areas in the United States.

(See photo next page)

COMPLETED LANDFILL - CITY PARKING LOT

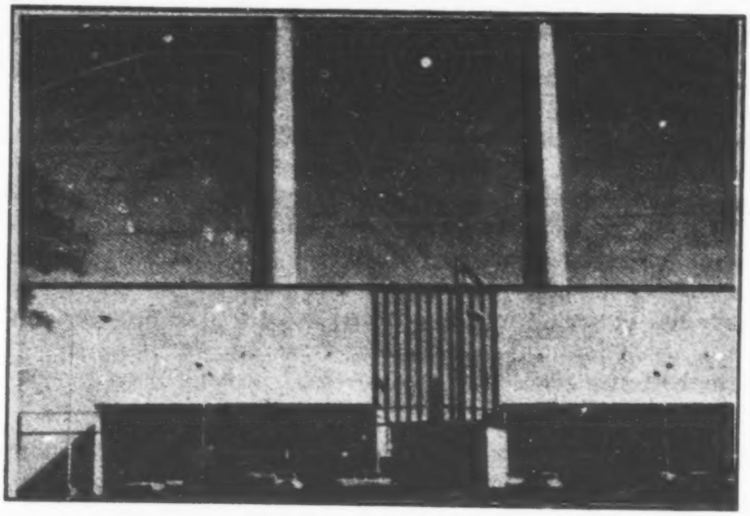
CENTRAL INCINERATION

A central incineration plant consists of one or more large furnaces for burning refuse at very high temperatures. The temperatures are controlled by varying the amount of air supply to the combustion chamber. Auxiliary fuel supplies are rarely used in municipal or privately owned central incineration plans. The added cost of the fuel does not warrant the use of it when controlled air supplies give satisfactory results.

Refuse from collection trucks is dumped in large storage pits at the receiving area of the plant. Overhead cranes then pick up the refuse in large clamshell buckets and deposit it in charging hoppers or chutes, which guide the refuse into the furances where the temperatures and the drafts are carefully controlled to insure combustion. The ash residue is then carried through a water bath for cooling and dumped into waiting trucks for hauling. The ashes and noncombustible residues are disposed of in sanitary landfills or salvaged.

Incineration has the following advantages: (1) it does not require a large site for the plant, (2) it can be centrally located in a collection area, and (3) it produces an end product that can be used as a fill material. The initial costs of a central incineration plant are high and the operating costs are higher than those for a sanitary landfill operation. It should also be noted that a landfill site is needed in conjunction with an incinerator plant. Ashes and residues from the plant should be disposed of by burial. Very wet or densely packed refuse often does not completely burn and when discarded at an open dump site may form breeding places for insects and rodents. The volume of the refuse fed to a furance is reduced by approximately 80 per cent through the combustion process.

From a health standpoint, central incineration is one of the most desirable methods. Recently many states have placed stricter controls on the flue gases emitted from incinerator stacks. To prevent air pollution many incineration processes now require the installation of certain apparatuses for removing the particulate matter from the flue gases. (See photo next page)

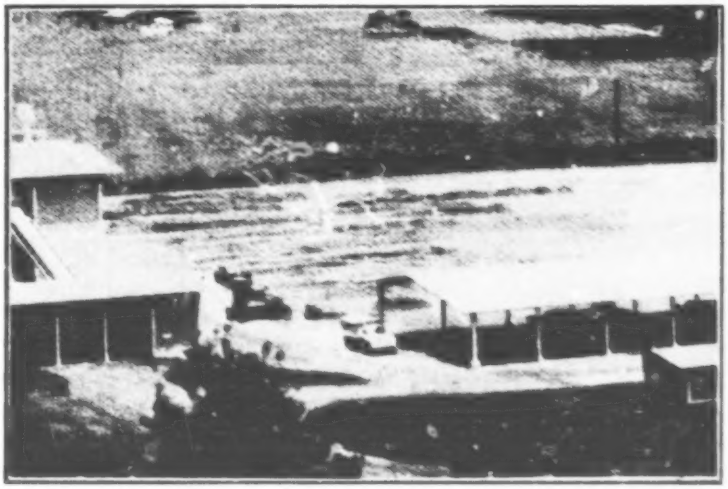


CENTER HILL INCINERATOR - CINCINNATI, OHIO

COMPOSTING

Refuse can be disposed of through the process of composting, which is the decomposition of organic matter, primarily garbage, to a relatively stable, humus-like material. This material is then used as a soil conditioner. Mixed municipal refuse is first sorted and then ground up into coarse particles 2 inches in diameter or less. Constant or intermittent mixing of the particles, dispersion of air throughout the material, and control of the moisture from 50 - 60 per cent are essential for good composting. This process produces considerable heat which is necessary for destroying disease producing organisms.

One of the advantages of this type of solid waste disposal is that the end product can be sold on the market. However, to date the market for compost has been very small and seasonal. Compost is not a fertilizer but is used only as a soil conditioner. Since it is not readily marketed, efforts at composting have failed many times in the United States. Compost is usually not purchased by farmers and local bag sales will dispose of only a fraction of the compost produced from a city plant. The total cost of the composting, less the revenue obtained from the sales, could give a cost comparable to that of incineration.



JOHNSON CITY, TENN. - COMPOST PLANT

FEEDING FOOD WASTES TO SWINE

Garbage can be disposed of by feeding it to swine providing it is properly cooked to destroy any disease organisms. Some commercial hog ranches in the United States collect garbage, excluding inedible refuse, on regular routes for feed for their hogs. The municipality has the responsibility of collecting all the refuse with the exception of the edible garbage that is stored in separate cans on each premise.

Because all states require that garbage be cooked before it is fed to hogs and most farms and ranches are located long distances from town, it has proven an uneconomical disposal method.

SALVAGE AND RECLAMATION

Until recently it has been common practice to regard salvage as not being an economical method of reclaiming materials. The terms "salvage" and "reclamation" indicate several methods of disposal: sorting of refuse either manually or mechanically, for metals, tin cans, glass, paper, rags, and other materials that can be resold; rendering of animal wastes to obtain fats, meat scraps for livestock feed and hair for insulation; dehydration of garbage to be used for hog feed; and composting.

Several studies are being made to develop economical, attractive, metallurgical or chemical processes for more efficient utilization of waste materials as opposed to permanent disposal. Residues from incinerators are being studied to determine what portion can actually be salvaged. The studies pointed out that the salvage of glass and all metallic materials in the residue could provide a source of revenue for municipalities. Salvage would also reduce by 50 per cent the volume of landfill required for disposal of the balance of the residues, thus doubling the life expectancy of residue landfill sites and reducing haulage costs by half. There is the possibility that further studies may bring to light more improved and more economical methods of salvaging materials. No city today uses salvage as a principal means of disposal; it is usually a partial method or a side-line of some other method. Decreasing prices for salvage materials and increasing labor costs frequently make it uneconomical.

DISPOSAL IN SANITARY SEWER

Some garbage now is disposed of in kitchen sink garbage disposal units which grind up the putrescible wastes and dispose of them in the sanitary sewer system. This method utilizes the sewage treatment facilities to render the garbage inert. Extensive use of garbage grinders by homeowners would contribute a tremendous amount of additional waste to the sanitary sewer system and in turn place a heavy burden on the treatment plant facilities. Wide usage of individual grinder units would in most cases require construction of additional treatment facilities including grinders and shredders to prepare the refuse for treatment. The material that could not be discarded into the sanitary sewer would have to be disposed of by some other means. This process is only a partial method of disposal and at present would not be practical for extensive use.

OPEN DUMPING AND BURNING

Open dumping and burning is now prohibited in most states as a means of disposal due to air pollution laws and other health reasons.

INCINERATION AT SEA

This method of disposal, considered by some cities, involves constructing an incinerator aboard a ship and locating it a considerable distance from shore. Garbage would be hauled from the city on barges to the incinerator for burning.

This type of system is one of many different methods of disposal being considered by large cities faced with the tremendous problem of too much waste.

BURIAL AT SEA

When garbage is compressed it sinks under water provided the mass is denser than the water. However, unfortunate results have plagued those who have attempted to dispose of waste in this manner. Water tends to swell some materials and to separate the compacted refuse. When the waste separates, a good portion of the material rises to the surface. As a result the garbage and waste floats and even comes into shore. This method of disposal is obviously not adequate from a health standpoint due to contamination and pollution of water and beach areas.

OTHER METHODS OF DISPOSAL

In Rosenheim, Germany an incinerator burns household and commercial refuse and transforms the energy into usable steam heat and electric power for the surrounding area. The electricity produced by the plant is nearly enough to supply all of Rosenheim. In addition the steam heat produced serves 90 stores, banks, schools, factories, office buildings and 458 private dwellings.

Munich, Germany also has an incinerator plant being used to produce steam and power. This plant is designed to burn both refuse and coal in different burners. It burns about 45,000 tons of refuse a month, disposing of 80 per cent of the debris created by Munich's 1,300,000 inhabitants.

A Tokyo industrialist has developed a process of converting refuse into cement-like building blocks. The blocks are made by compacting the baled refuse under immense pressures and encasing the resultant solid material in asphalt, cement, vinyl or iron sheeting. The blocks can be any shape and made for interlocking if desired. A standard-size block weighs 2 tons. This process has several advantages: (1) the volume of the refuse is reduced, (2) the cost of the process is claimed to be less than that of incineration, (3) there are no smoke or fumes produced to cause air pollution, and (4) the building blocks are a marketable by-product (of limited use).

Another method utilizes pulverizers with power driven hammers which smash up all types of rubbish and refuse into a compact granular pulp that reduces the volume by one-half. The compacted pulp is then buried in landfills.

The National Aeronautics and Space Administration is examining ways to use waste matter for conversion to space fuel. After lift-off, a manned spacecraft could use fuel made of waste for propulsion. The waste produced from inside the craft would be mixed with some type of material to aid in combustion and the combination would be used as fuel.

SECTION VIII - CASCADE COUNTY-WIDE PLAN

GENERAL

Physical Characteristics

Cascade County is located in north central Montana, is bordered on the south by the Big Belt and Little Belt Mountains, on the east by the Highwood Mountains, and on the west by the Rocky Mountain Range. The terrain consists of a series of low divides and basins forming a transitional area between the different mountain groups and the rolling plains to the north and east of the county.

Drainage

From southwest to northeast the Missouri River flows diagonally across the county through a wide valley. The Sun River drains the northwest portion of the county; the Smith River drains the south central portion and Belt Creek drains the east section.

Climate

Since it is located in the Central Plains Region east of the continental divide, semi-arid climate prevails over the majority of Cascade County. More moisture is experienced in the south and east portions of the county with comparatively lower precipitation amounts falling in the northwestern area. Most of the precipitation occurs from latter March or early April through September in the form of rain and small amounts of snow. The average frost free growing season in the county is about 135 days.

Soils

There are 26 different types of soils in the county, including clay loams, silt loams, fine sand loams, gravel loams and stony loams. Some of the stony and rocky areas are not suitable for farming, but the majority of the loam soils are suitable for either small grains or grazing land.

Population Density

In an area that is sparsely populated it is uneconomical to set up an organized refuse collection program to serve every farm, ranch and remote dwelling. In Cascade County the majority of the populace is located in and around Great Falls. Excluding Great Falls, the population density of Cascade County is close to 6 people per square mile. However, this figure is misleading as it includes 13 cities, towns and communities in the county with populations varying from 100 to 900. It is evident then that Cascade County with a land area of 2673 square miles and a total population of about 91,800 is sparsely populated in the rural areas. The majority of the population is concentrated in the cities, towns and communities. Farming and ranching are the major sources of income for the populace living in the rural areas. The population density of an area determines the need and feasibility of an organized collection service. In rural or fringe areas where the population density is small, refuse is disposed of by the individual homeowners without causing a nuisance. In these rural areas it would be uneconomical to attempt to provide collection service for the people. As the population density increases public health dictates the need for organized collection service. Random dumping and the appearance of unsightly roadside dumps emphasize the esthetic, public health and nuisance aspects of the existing methods of refuse disposal. Roadside dumps and indiscriminate dumping practices are becoming more prevalent every year in Cascade County.

Organized System

In Section III of this report the existing methods of collection and the conditions of the disposal areas were discussed in detail for each city, town and community in Cascade County. It was brought out that Great Falls and Belt were the only areas that have an organized collection service. Great Falls has the only sanitary landfill site where refuse is covered daily. The majority of the remaining areas in Cascade County use open dump sites for refuse disposal and periodically bury the refuse when accumulations of the waste become too great. Even though the residents of these areas are aware of the unsightliness of the disposal areas, they are unable to do anything to eliminate the problem. A community with a population of 100 or 200 is usually financially unable to purchase a vehicle for use in collection or a dozer for use at a landfill operation. Many of the people in these areas have their own wells for water supply and a septic tank is utilized for sewage disposal. The charge for an adequate community collection and disposal service would appear too expensive since many of the homeowners pay no water or sewer charges. Generally the people living in these small towns and communities are in the farming or ranching business, and have trucks which can be used for hauling refuse to the disposal site.

Areas Served by Collection and Disposal Service

The quantity of refuse produced by a community with a population of less than 900 could be collected in one day. If a community obtained its own collection equipment and used it one day per week the remaining portion of the week the equipment would be idle. However, if several communities, towns and cities shared the same collection and disposal equipment, the rate charged for the service would be much more reasonable. Collection service would include the small communities and surrounding areas but would generally exclude the rural ranches, farms and dwellings.

Disposal areas would be located to serve the entire populace of the county and not just the densely settled areas. Sanitary landfill sites located throughout the county would be used for disposing of refuse collected on the county-wide collection system and also refuse disposed of by individuals off the collection route. Equipment transported from site to site would be used to maintain the sanitary landfills in a satisfactory, economical manner. Cascade County is quite large and the outlying landfill sites are serving moderately populated areas. It would probably not be necessary or economical to service the landfill sites daily due to the small amounts of unscheduled dumping occurring there. Landfill operation equipment obviously can be best utilized on a multi-site basis.

Existing Private Collection Services

There are several private collectors presently operating in Cascade County. These private refuse collectors should be allowed to continue their service, on a contract basis, after an organized county wide collection program is put into effect. All collectors, however, should be required to conform to the regulations set forth by the city-county controlling body.

Adequate Disposal is Required

The Montana State Department of Health adopted a regulation during 1966 governing the control and licensing of refuse disposal areas throughout Montana. This regulation prohibits operation of open dump sites for refuse disposal.

ALTERNATE STUDY AREAS

To determine a workable program of storing, collecting and disposing of refuse 2 different study groups of cities, towns and communities were used to determine the most effective combination.

Exclude Great Falls Urban Area

The first analysis excludes the City of Great Falls from the county-wide program but includes the Great Falls fringe area outside the city limits. Under this analysis the Great Falls urban area would be the only populated area in the county excluded from the county-wide collection program. All other areas of concentrated population would be included. The Great Falls urban area has been excluded from the first analysis because the City of Great Falls presently operates its own organized collection service and sanitary landfill.*

Include Great Falls - Alternate

The alternate analysis of the comprehensive study includes Great Falls as well as all the other populated areas in the county. This analysis assumes that the City of Great Falls would become an integral part of the county wide collection and disposal service.

** Operating practices at this facility make its designation as a "sanitary landfill" inappropriate. It should, rather, be termed a "landfill." (BSWM)*

The advantage in making two analyses is that it will indicate which method will be more economical for all concerned.

STORAGE

Type of Containers

A collection service in Cascade County would include mostly residential pickups with limited commercial pickups. A container used for mixed domestic refuse which includes garbage should be constructed of rust resistant metal or galvanized iron, be watertight, and be fitted with a fly-tight cover or lid. Rubber garbage containers are not recommended due to the deterioration effect caused by exposure to greases and fats. All containers and covers should be equipped with handles to aid the collector in the pickup operation. Adequate covers should be used at all times on refuse containers to curtail fly production and to prevent the scattering of papers by the wind. Tight fitting lids also discourage animals from tipping the cans over in search of food.

Well constructed seams and tight fitting joints are a must on refuse containers to prevent accumulations of garbage from forming in corners, joints, ledges or other uneven surfaces. Smooth interiors are essential to allow for adequate cleaning of the containers. Structurally the containers should be strong enough to withstand normal handling stress. Tapered sides are also advantageous in that the refuse is easily emptied from the container.

Capacity of Containers

A refuse container should be of sufficient capacity to keep the number required to a minimum, but not so large that normal refuse will make the container too heavy for easy handling by one man. The conventional heavy duty galvanized garbage can with the recessed bottom is the best type of storage container available. It is recommended that only this type of container with a 32 gallon maximum capacity be used throughout Cascade County.

The results of an environmental sanitation survey completed by the City-County Health Department in Great Falls in early 1968 indicated the following: of 3,861 premises using galvanized containers 87 per cent had acceptable garbage storage; of 9,490 premises using barrels 30 per cent had acceptable garbage storage. Cascade County has fallen behind most cities of the nation by continuing to allow the use of 55 gallon drums for garbage storage.

Racks

All containers kept outside should be elevated 12 inches above the ground on a suitable rack. The area surrounding the cans should be enclosed on 3 sides to maintain the cans in an upright position. The lids should be attached to the rack with a chain to prevent them from being lost or damaged. Racks, stakes or holders shall be designed so as to prevent the containers from being tipped. Well arranged containers convenient to the collectors result in better and faster service for the customer.

Location of Containers

Refuse containers should be placed in a location convenient to the collection crew. Alleys should be utilized for container storage or placement on the scheduled day of pickup. The collectors should not be required to walk on the homeowners' premises to pick up the refuse. In areas where there are no alleys, refuse containers should be set out in front of the homes on the scheduled day of pickup. The homeowner has the responsibility of setting the container out for pickup with the understanding that the collection crew will not stop if the container is not out. Each homeowner would be informed of the scheduled day for collection. Should bad weather prevail there may be delays in the collection service and the homeowners may be required to leave the containers set out for several days until the collection crew can get to their area. The alley location for storage containers is preferred since the containers can be stored there permanently without causing undue nuisance conditions. Another advantage of alley storage is that collection delays caused by inclement weather or holidays will not necessitate leaving unsightly containers in front of homes. Homes located on travel routes between communities are eligible for collection service if their refuse container is located on a turnout or frontage road. Storage containers placed along frontage roads or in front of homes must be removed after collection to prevent unsightliness.

Use of Bulk Containers

Bulk containers are effectively used to decrease pickup time when the number of 32 gallon containers per service becomes too large. We recommend that a maximum of four 32 gallon containers be allowed per service. If more than four 32 gallon containers are required to hold the accumulation of refuse, the home or establishment should obtain a bulk container. Three 32 gallon containers are nearly equivalent to the capacity of a 1/2 cubic yard bulk container. The use of bulk containers would decrease the loading time and result in better sanitary conditions. The metal bulk storage container must be of a type suitable for the dump mechanism on the collection vehicle. Since the loading time for bulk containers is less than for numerous small containers, consideration in the service charge should be given to businesses with bulk containers.

Storage of Rubbish

Accumulations of lawn and yard trimmings, small scraps of wood and other rubbish should not be placed in the regular refuse container but should be placed in a durable container not exceeding 2 feet x 2 feet x 2 feet dimensions. Bulky material should be reduced in size so that it can be placed in this box and handled by one man. An acceptable alternate to this would be tying yard trimmings into bundles not exceeding 4 feet in length, 18 inches in diameter and 50 pounds in weight. Cardboard boxes used for containers would not be acceptable if deteriorated by the weather. Metal containers should not be used for grass cuttings due to the dampness that develops in the container and the subsequent rotting action on the grass.

Ashes should be stored in fire-resistant containers with close-fitting covers. The containers should be equipped with adequate handles and should be of a weight easily handled by one man. Ashes containing hot embers should not be placed in containers for collection.

It should be unlawful to permit refuse to accumulate on premises except in adequate containers. However, bulky rubbish that does not cause a nuisance would be an exception to this limitation.

ON-SITE DISPOSAL OF SOLID WASTES

On-site disposal facilities are normally used by commercial firms that haul their own refuse to the disposal site. Less haul trips are required if the volume of refuse is reduced before loading. Presently there are numerous types of compacting units available on the market and any commercial firm interested in on-site volume reduction should have no problem satisfying its needs. The use of incinerators and backyard burners is expected to decline as restrictions are placed on emissions of particulate matter.

COLLECTION

It is recommended that a county-wide system be initiated to serve all those areas of concentrated population. A county-wide collection service would consist of several collection vehicles serving designated areas throughout the county.

Collection Areas

It is not feasible or necessary to collect refuse from every home, ranch, farm and commercial establishment on a county wide basis. The areas to be served by an organized collection system would include the City of Belt, the Town of Cascade and the communities of Centerville, Fort Shaw, Monarch, Neihart, Sand Coulee, Simms, Stockett, Sun River, Tracy, Ulm and Vaughn. If the City of Great Falls chooses to be included in the county-wide system, collection for the entire metropolitan area will be integrated. If Great Falls is not included in the system, collections will be made in the areas adjacent to the city limits.

Collection vehicles en route from one scheduled collection area to another, would pick up services along the route. It is not feasible to drive off the main route to service isolated homes. Areas to be served on a travel route would include services located between Monarch and Neihart, those southwest of Cascade on U. S. Highway 91 and those between Simms and Vaughn on U. S. Highway 89.

Population Projection of Collection Areas

In order to estimate the amount of refuse produced by an area it is necessary to determine the population of the area. A population study, using several approaches, was made by the Great Falls City-County Planning Board during February of 1968. Consideration was given to Volume IV of the "Great Falls Urban Transportation Survey" of 1961, the "United States Census of Population" and Rand McNally's"Commercial Atlas and Marketing Guide". Population was projected on the basis of the 1960 to 1967 school district census. These projections were then confirmed by interviews with residents of the various towns. A summary of the resulting populations are given in Table 1. A discrepancy exists between the projections made using the transportation study and those made using the school census material. The discrepancies could be caused by unsimilar boundaries between school districts and population census areas. The 1968 and 1988 population figures may be high but they are on the safe side for computing refuse quantities. Populations of cities, towns and communities were increased to indicate the population of the total areas that would be served by the county-wide collection service and these figures are shown in Table 2. The populations indicated for the collection routes for 1968 and 1988 include the metropolitan areas, and an allowance for people on travel routes between towns. The population of metropolitan Great Falls has been separated into that within the city limits and that in the fringe area.

Refuse Production per Collection Area

Because of the lack of records it is difficult to determine the quantity of refuse produced per person in Cascade County. None of the disposal sites operate a weigh scale to determine the daily weight of refuse hauled. To effectively determine the routing and type of equipment required for an organized collection system, it is necessary to know how much refuse will be produced. National averages, from other studies, indicate that total refuse production in 1967 was between 4.5 and 5.1 pounds per capita. Total refuse includes residential, commercial and industrial wastes.

To determine the amount of refuse produced in this area, an actual field study was made on the collection vehicles used by the City of Great Falls. Each day of the field study a different three-man collection vehicle was followed on its route by the survey crew. Five different collection vehicles representing routes from five different areas in Great Falls were studied. Each of the 18 cubic yard collection vehicles served three routes per day and dumped refuse at the disposal site three times per day. During the collection phase the survey crew recorded the number of services (dwellings), the number of containers collected, and the length of each collection route. At the completion of each route, the collection vehicles were weighed to determine the weight of refuse collected. Scales are not available at the Great Falls landfill site so normal operation does not include weighing refuse collected. By using the weight of refuse collected on each route, the number of services picked up, and an average of 3.2 persons per service, it was possible to determine a per capita refuse production rate. An average of the 15 residential collection routes equaled 1.9 pounds per capita per day during the winter. Since refuse production increases during the summer, 2.1 pounds per capita per day was used as an annual average. As a verification of the per capita figure, a cross check was made by totaling all the loads collected in the entire Great Falls area per day and multiplying the total number by the average truck weight determined from the field study in Great Falls of specific collection routes. The resulting total weight of all the refuse collected in Great Falls by collection vehicles was divided by the population on the routes, to determine the per capita figure. This method gave a daily rate of 2.2 pounds per capita. Other areas around the United States indicate an average over the year of about 2.5 pounds per capita per day for residential areas. Because of the short period of time covered during the Great Falls field survey and the time of the year that the survey was completed (winter), it was felt that the more conservative figure of 2.5 pounds per capita per day should be used for the quantity of refuse collected by collection vehicles on regular routes. Refuse production is currently increasing at a 2 per cent rate per year. At this rate by 1988 residential refuse production will be 3.5 pounds per capita per day. These rates are required to project the needs for collection facilities.

In Table 2 the volumes of compacted refuse produced per week by the cities, towns and communities in Cascade County are shown for 1968 and 1988. The compacted volumes are based on the use of mechanical packer vehicles for collection.

The total amount of refuse discarded at a disposal site will be greater than that actually hauled to the site in collection vehicles, since private individuals, as well as industrial and commercial organizations, will be hauling additional refuse to the disposal sites. To determine the necessary volume of disposal sites, a total refuse production of 4.5 pounds per capita per day has been used. This figure allows for residential, commercial and industrial wastes. Using a 2 per cent increase per year, the average refuse production rate between 1968 and 1988 will be 5.6 pounds per capita per day. Table 3 shows the "Sanitary Landfill Requirements"

Route Analysis

To determine the equipment and labor requirements for an organized collection route, it is necessary to compute the time required for the pickup operation in each area, the travel time between areas, and the travel time to the sanitary landfills.

Collection Vehicles

Mechanical packer type collection vehicles are used throughout the Great Falls area and this type of vehicle is recommended for county-wide use. Obviously, crew efficiency decreases with an increase in the number of trips to the disposal site. To keep the number of haul trips at a minimum, mechanical packer units can be utilized successfully.

A mechanical packer collection vehicle is capable of carrying more refuse than a non-compacting truck body of the same capacity. Initial costs, as well as operation and maintenance costs are higher for mechanical packer units than for non-compacting units. Present prices for 17-18 cubic yard mechanical packer collection vehicles, complete with 3-5 ton chassis, will range from $11,000 to $14,000. A 3-5 ton truck, complete with an 18 cubic yard open body, may be obtained for approximately $8,500 to $10,000. The operation and maintenance costs of a non-compacting vehicle will be approximately 75 per cent of those for a mechanical packing unit. The primary advantage of the mechanical packer unit is that less haul trips are required from the collection area to the disposal site. Other advantages are the low loading heights of the refuse receiving hoppers and the esthetic and public health benefits derived from a completely enclosed refuse truck. In computing collection and hauling time requirements, an 18 cubic yard mechanical compactor vehicle was used for design computations. Mechanical packers compress 1.36 cubic yards of open truck type refuse to 1 packer yard of refuse. This ratio was used in determining the volumes of refuse given in Table 2.

Crew Size

In determining a routing system it is necessary to determine the size of crew that will be the most economical for the operation. A study made by the Refuse Disposal Division of the Sanitation Districts of Los Angeles County in California indicates that there is comparatively little difference in the collection cost per route for different sizes of crews. However, with a countywide collection system which entails considerable road travel, 3-man crews are more costly than 2-man crews. The amount of time required for each man to pick up a ton of refuse is nearly the same for either a 2-man or 3-man crew. The haul distance to the disposal site therefore becomes the governing factor in determining the relative efficiency of 2 and 3 man crews. All routings for the county-wide collection program excluding the Great Falls area are computed on a 2-man crew basis. One-man crews are not recommended for operating mechanical packer equipment.

The City of Great Falls is served weekly by 11 vehicles collecting 167 routes and 1 private vehicle collecting 17 routes for a total of 184 routes per week. Three-man crews have proven satisfactory in this area where travel distances are relatively short. We are therefore recommending 3-man crews for the Great Falls metropolitan area.

Scheduling

Cascade County has been divided into 3 separate routing systems. Great Falls and the surrounding area make up 1 section. The geographical layout of the towns and highways in the county indicate a natural dividing of the county into eastern and western sections. The eastern area includes Belt, Neihart, Monarch, Tracy, Sand Coulee, Centerville, and Stockett. The western division includes Ulm, Cascade, Simms, Fort Shaw, Sun River, and Vaughn. Table 4 gives the routing for 1968 and Table 5 gives the routing for 1988.

In the eastern division the collection vehicle would be headquartered at Belt. On Monday, for once per week collection, the truck would be driven to the Tracy-Sand Coulee, Centerville, Stockett area for collection of refuse there. The collection operation in this area would require 11 hours 20 minutes, not including travel time to the disposal site. Monday night the collection vehicle would be left at the county shop in Stockett. After completing collection Tuesday morning the truck would proceed back to Belt to finish out the day. Wednesday the truck would be taken to Neihart, collect refuse there, drive to Monarch, collect refuse there, and haul material to the disposal site in that area. Wednesday afternoon the truck would return to the Belt county shop. Thursday the collection crew would finish collecting the Belt area. The total collection time and road travel time for this route, based on once per week pickup, would be about 30 hours, excluding travel time to sanitary landfills. The time required for the same routing using twice per week collection would be about 52 hours.

Routing for the western division could be based at any of the communities along the route. However, collectors would want to arrange the routing so as to be within commuting distance of home each night. An automobile or pickup would be provided for the required commuting. If the route begins at Vaughn on Monday morning, the refuse collectors would cover the Vaughn area, dump the refuse at the area landfill and proceed south over the Ulm-Vaughn road to Ulm. Monday night the collection vehicle would be left at Ulm. Tuesday morning the Ulm area would be completed and the crew would proceed to Cascade and collect the refuse there. Dumping would be accomplished in that area by Tuesday night. Wednesday morning the truck would proceed north out of Cascade to Fort Shaw. The Fort Shaw, Simms, Sun River area would be collected and the refuse dumped at the area landfill site. Wednesday night the truck would proceed back to Vaughn. Additional route pickups may be necessary on U. S. Highway 91 southwest of Cascade near Hardy and also on State Route 200 and U. S.

Highway 89 between Simms and Vaughn. This western route should require about 24 working hours for once per week pickup. The same route with twice per week collection would require about 40 hours when figured on a 1968 refuse production basis.

Table 5 shows that by 1988 the eastern route time would be about 58 hours and 99 hours for once per week and twice per week pickup respectively. The times for the western route would be 44 hours and 74 hours.

The third area is adjacent to the Great Falls city limits. Actual population figures for this area vary from year to year depending on how much area is annexed to the City of Great Falls but it is estimated that 4,000 people live in the fringe area at the present time.

Assuming that Great Falls continues their operation of collection in the city limits, the Great Falls fringe area analysis as given in Table 4 indicates that it will take a 2-man crew about 37 hours for once per week pickup and 63 hours for twice per week pickup. For a 3-man crew and twice per week service, the total time required for collection would be 40-1/2 hours. A 3-man crew using 1 packer type collection vehicle could serve the Great Falls rural or fringe area adequately with twice per week service in a regular work week. The times given here do not include travel time to and from disposal sites and collection time for additional pickups on scheduled routes. Initially, this time would be of little significance because the disposal sites are in close proximity to the collection routes.

Because of the continuous growth in the Great Falls area an evaluator is needed to assist the superintendent in establishing collection routes. Refuse hauled to the sanitary landfill should be either continuously or periodically weighed to determine the amount of refuse being collected per crew. By periodic re-evaluation of the routes, more effective service can be maintained. It is impossible to determine truck routes without getting out in the field and working with the men and the trucks. The effectiveness of an organized collection program depends a great deal upon how well the routing system is laid out for the collection crews. The evaluator will also determine the charge rates for the commercial services. The rates of commercial services should be continuously re-evaluated. If volume or type of business changes the amount of refuse, a corresponding rate adjustment should be made.

An analysis was made, during the winter of 1967-1968, of the time required to collect refuse by the crews operating in Great Falls. A 3-man crew collecting once per week averaged 100 man-minutes per ton of refuse collected. A California study indicates an average collection time of 135 man-minutes per ton of refuse collected. Tables 4 and 5 are based on 100 man-minutes per ton in the densely populated areas and 135 man-minutes per ton in the rural areas. The latter rate has been applied to the 2-man crews which are proposed for the rural areas. According to the California study, collection crew requirements vary with the frequency of collection. Results from the study indicate that the twice per week total labor requirement would be 1.67 times that required for once per week pickup. This adjustment has been applied to the collection time required for twice per week pickup.

Frequency of Collection

From the preceding section it can be seen that twice per week pickup requires about 74 per cent more time than once per week pickup for the eastern and western area routes. Great Falls and the surrounding area requires about 65 per cent more time for twice per week pickup. As previously mentioned, twice per week collection is desirable from a public health aspect. The need is more critical in the congested area. We are therefore recommending twice per week collection in the City of Great Falls and once per week in the other areas.

Going to twice per week pickup for the City of Great Falls will require 1.67 times as many collection vehicles. This is an increase from 12 to 20, with one additional vehicle being required for the area outside the city limits.

Refuse produced by commercial establishments may require more than once per week pickup service. The collection vehicles in rural areas may not be able to serve some of these firms more than once per week. In Great Falls and the surrounding area, additional service would be available.

Collection Equipment Required

Non-compacting versus compacting type collection vehicles were previously discussed under "Route Analysis". It was brought out that mechanical packer collection vehicles would give the best service on a county-wide basis. The units should not be too large in capacity so as to hamper their maneuverability through alleys or excessively reduce their ability to travel mountain grades.

Capacity of Vehicles

Capacities of packer units available on the market vary from 10-40 cubic yards with 15-25 cubic yard units being the most widely used. An 18 or 20 yard mechanical packer unit would adequately serve each of the 3 areas specified for the county-wide collection service. Three collection vehicles would service the county-wide collection area excluding Great Falls.

Safety Devices

Employee health and accident prevention are important considerations in a solid waste program. Injuries are often directly related to the types of equipment used. Although safety devices are a must on collection vehicle equipment to help prevent accidents, they are often eliminated in order to lower the price of a unit to fit a budget.

Mechanical packer units are available with many safety features which should be purchased with the unit. Safety doors are available to cover loading hoppers during the packing cycle. Dual packer controls can stop the packing mechanism should either loader become entangled in the refuse or equipment.

Brakes should be frequently checked on all collection vehicles to make sure they are in good working order. Hand brakes often will not hold on relatively flat grades. All parts of the collection vehicles should be kept in good working order at all times.

Crew Organization

Incentive type collection programs are excellent means of promoting collector efficiencies. A crew that is allowed to leave a job early after completing a predetermined route will normally give better performance than one that is required to work a set hourly day or week.

In setting up a multiple area collection route it may be convenient for the crew to work some long days and some short, either to complete a certain pickup area or to decrease travel time the next day. It is very important that the collection day for each area be the same every week to accommodate those people who have to set out their refuse containers.

Once the collection areas are set up, the sanitation superintendent can figure the routing on a daily basis. The route can be determined to allow the workers to complete 40 hours work in about 36 hours per week. For those routes that can initially be collected in only a 4-day week, the crews can be used for restitution of unsightly, abandoned dumps.

It is necessary to have a superintendent in charge of all county collection routes. He would be required to set up the routes for all crews, check crew efficiencies on incentive type routes, increase and decrease routes as necessary and insure that the public is getting 40 hours work from every crew. Any complaints from the public or the collection crew will also be field investigated by the superintendent.

DISPOSAL

General

In Section VII several different methods of refuse disposal were discussed. The only complete method of disposal of all types of refuse is the sanitary landfill, which is the most suitable means for disposing of refuse in Cascade County.

Sanitary Landfill Disposal Sites

Areas Served

As mentioned previously, the county-wide collection service would be set up to serve only the areas of concentrated population. However, the disposal sites would be available for serving the entire county population. The sanitary landfill sites would be located near the more populated areas to serve the majority of the population. Even though the distance across the county varies from 50 to 80 miles, the maximum distance from any remote dwelling in the county to a landfill disposal site would be 25 miles.

Existing or New Sites

Existing open dump sites will be converted and re-designed to serve as sanitary landfills if they are suitable for this type of operation. Those sites that have unacceptable features such as surface water flow, hilltop location, steep and inaccessible access roads, or lack of space would be abandoned. The Cascade County map shown in the appendix of this report indicates the proposed sanitary landfill sites. Existing sites to be used are at Monarch and Cascade. Proposed new sites are shown for: Belt, Stockett-Sand Coulee-Tracy area, South Great Falls (Rural), Vaughn-Ulm area, and Simms-Fort Shaw-Sun River area. Should the City of Great Falls choose to be included in the county-wide program, the existing sanitary landfill north of Great Falls would be utilized for the refuse produced in the metropolitan area north of Central Avenue and the remaining portion would use the proposed sanitary landfill south of the city. The City of Great Falls wou'd benefit by having 2 sanitary landfill sites controlled and operated by one city-county organization. As the city enlarges, the land costs will increase, and landfill disposal sites will become more difficult to obtain. Many growing cities have not had the foresight to obtain land for future disposal sites and have been forced to use the more costly method of central incineration for refuse disposal.

Landfill Site Acreage Required

A 20 year design period has been used for landfill requirements. Table 3 gives the acre footage required for each landfill site. (One acre foot equals one acre of area one foot deep) A 1967 figure of 4.5 pounds per capita per day was used for the total amount of refuse produced per person. This figure is the result of several studies run throughout the United States and refers not only to refuse picked up by collection vehicles but also includes tree trimmings, old car bodies, etc. Using a 2 per cent increase per year for refuse production gives a 1988 figure of 6.8 pounds per capita per day. The average refuse production during the 20 year period would be 5.6 pounds per capita per day. Based on a density of 1,000 pounds per cubic yard for compacted refuse, 25.8 acre feet would be needed per 1,000 people for 20 years. The acre feet of volume required for refuse is obtained by averaging the population figures for 1968 and 1988 given in Table 2, and multiplying by 25.8 acre feet per 1,000 population.

Proposed Sanitary Landfill Sites

Proposed sites are shown on the Cascade County map and on the township maps in the appendix of this report. The existing sites near Monarch, Cascade and Great Falls proper are the only sites presently being used that are suitable for future sanitary landfills. New sites are proposed for all the remaining areas as listed in Table 6.

The Monarch site which will serve the Monarch-Neihart area is located in Section 3, Township 15 N, Range 7 E. The general type of soil in this area consists of silts and silty loams with a Federal Aviation Agency classification of E-6. The site should be enlarged to the west of the existing site to include one more acre of disposal area, or a total of about 1.7 acres of useable disposal area. In computing the landfill volume requirements an average population of 339 and a landfill depth of 6 feet were used.

In the Belt area a minimum of 5.5 acres with an average depth of 6 feet are required. The existing disposal site is too small and a new site adjacent to the Orr Coulee road in Section 23, Township 19 N, Range 6 E is proposed. The site location, which is near the county road, appears to be the only available site in the area. Surface water is a problem around Belt and adequate cover soil is difficult to obtain. At the proposed location the gentle slope of the existing ground will be suitable for the trench type method of sanitary landfilling. Soil in this area consists of a poorly graded fine granular soil with a classification of E-5.

A proposed site for the Stockett-Centerville-Sand Coulee-Tracy area is located in Section 20 and 21, Township 19 N, Range 5 E. This site would begin at the upper end of a coulee located near the Hasting road and run parallel to the Frenchman Hill road. Minimum acreage required for this site would be 5.1 acres with an average depth of 8 feet. By using the upper portion of the coulee, the site will be partially hidden from the view of passing motorists. This site would serve all four towns in the area. The soil classification for the proposed area is E-6, and consists of silts and silty loams.

Future use is limited at the existing open dump sites at Ulm and Vaughn. Because of the limited space, conversion of the existing sites to sanitary landfills is not possible. A site located 1/2 way between Ulm and Vaughn in Section 18, Township 20 N, Range 2 E will serve both towns. Figuring a depth of 6 feet the landfill minimum acreage requirement is 4.7 acres. The Ulm-Vaughn road requires some additional gravel to upgrade the surface. Although the soil types vary throughout the area, a large portion is E-6. The area also contains some clay type (E-7) soils.

Cascade presently has an open dump site located in Section 26, Township 18 N, Range 1 W which can be converted to a sanitary landfill site. The existing acreage should last approximately 10 more years. Adjacent land to the northeast should be obtained for future expansion. Figuring a 6 foot depth of refuse the landfill acreage requirement is 4.5 acres. Since the existing site has 2.3 acres of land available, an additional 2.2 acres are required. The land to the northeast is not contiguous with the existing site because of a coulee that must be maintained for drainage. The trench method could be used on this land to the northeast of the coulee. The soil in this area consists of silts and silty loams, classification E-6.

A new sanitary landfill site located in Section 18, Township 20 N, Range 1 W would serve the Fort Shaw-Simms-Sun River portion of the county. Figuring a 6 foot refuse depth, the minimum landfill area requirement is 2.2 acres. The proposed new site would begin at the upper portion of the coulee and proceed downward. Knapstad road, which is well graveled, is within 1,500 feet of the proposed location of the sanitary landfill. This site, being close to Fort Shaw, is centrally located to serve Simms, Sun River, and the surrounding area. The soil here consists of a fine sandy material with a classification of E-2.

South of Great Falls in the S.E. 1/4 of Section 30, Township 20 N, Range 4 E is the proposed site for a new sanitary landfill which will serve the surrounding area of Great Falls. A 22 acre area is needed based on a 6 foot depth and a 20 year design period. Filling would begin at the upper portion of the 1/4 section and proceed downward in the coulee. Care would be taken to provide for proper drainage around the fill. The best location for an access road would be an extension of 26th Street South. A sandy soil exists in this area. The capacity of this site is near 5,000 acre feet which would serve the rural area and a large portion of Great Falls proper for more than 20 years.

The City of Great Falls is presently disposing of refuse in a sanitary landfill* located in the N.E. 1/4, Section 32, Township 21 N, Range 4 E. This land is leased to the city and will eventually be returned to the landowner for use as farm land. Future projections as given in Table 6 indicate that the existing site will last for about 7 more years. An additional area adjacent to the existing site will serve another 6 months to a year giving a total of about 8 years useage.

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* *Operating practices at this facility make its designation as a "sanitary landfill" inappropriate. It should, rather, be termed a "landfill." (BSWM)*

A large portion of the soil in the area now being used is classified as E-6. A clay type soil, classification E-7, is also prevalent.

Proposed sanitary landfill disposal sites are shown on topographic maps in the appendix of this report. Proposed access roads, fences, and ditches are also indicated.

Bulk storage containers would be located near the entrance to unattended landfill sites for receiving waste hauled to the site by private individuals. The waste dumped in the bulk containers would be buried in the landfill on the scheduled collection day for that area. Bulk containers from 1 to 2 cubic yards capacity can be emptied into the loading hopper of a mechanical packer vehicle using standard apparatus. However, for containers in the 2 to 8 cubic yard capacity range, an additional winch must be installed on the mechanical packer unit for lifting and dumping the larger bulk containers.

OPERATING EQUIPMENT NECESSARY FOR LANDFILLS

In the Cascade County-Wide program both the area fill method and the trench method will be used for disposal of solid wastes. Because of the different soil conditions of the sites and the different methods of disposal to be used, a multi-purpose piece of equipment is required to operate and maintain all of the sites. The equipment must be capable of transporting refuse, spreading and compacting it, and covering it with soil. A piece of equipment should be capable of excavating and carrying cover soil several hundred feet.

It is not feasible to purchase equipment for assignment to each landfill in the county. It appears that the most economical way to maintain these landfill sites is to utilize equipment on a transport basis. The equipment would be hauled from site to site at least once a week. Other equipment as may be needed could be rented. No open disposal would be made at the sites except during the day that equipment is at the site to cover the refuse. Covered containers would be available for refuse disposal on other days.

A wheel loader is the most versatile piece of equipment available for county-wide landfill maintenance. The prime drawback of this type of unit is the susceptibility of the tires to puncture. Either steel impregnated puncture-resistant tires or rock tires are available for protection against breaks, punctures, and blowouts. The wheel loader has maneuverability, is capable of carrying refuse and cover soil, and can excavate cover soil when necessary. A multi-purpose bucket fitted to a wheel loader is a utility tool which can haul and bulldoze both topsoil and debris. The wheel loader should be in the range of 100-115 fly-wheel horsepower. Such a unit equipped with a multi-purpose bucket costs from $25,000 to $31,000. The rubber tired wheel loader can be loaded on a lowboy trailer for transporting from site to site. Tilt type trailers, which eliminate the need for a loading and unloading dock, are available for hauling loaders behind trucks. The Montana Highway Department specifies the maximum width of the loader and trailer.

It is always advisable to have a piece of standby equipment available in case of emergency. A crawler tractor with a dozer blade could be used for excavating refuse trenches periodically and for serving in emergencies when other equipment is being repaired. Because of the minimal need for the crawler tractor and dozer it is advisable to rent this equipment.

If punctured tires become a problem, steel cleated traction wheels are available for installation over and around the rubber tires. These steel encasements completely cover the rubber tires and provide steel cleats for crushing and demolition action. Steel wheels such as these cost from $5,000 to $6,000 for a set of four.

A tilt type lowboy trailer for transporting the wheel loader costs $3,000 to $3,500. It is necessary to have substantial truck rear axle weight ahead of the trailer to control the load. A 1-1/2 ton flatbed truck with a 375 to 400 cubic inch engine would be suitable for towing the trailer. This truck could also be used to carry a fuel tank, tools, fencing and other accessories for landfill maintenance. The truck can be purchased for approximately $4,000 to $4,500.

The Great Falls sanitary landfill presently uses a Caterpillar 977 crawler loader, an International TD 15 crawler dozer, and a Heil 11 cubic yard scraper or earth mover. The Caterpillar 977 crawler loader, which was purchased in 1961, has extremely high maintenance costs. The TD 15 crawler dozer, purchased in 1966, is used in the refuse compacting and burying operation. After the final lift of refuse is dumped, the scraper is attached to the TD 15 and used for hauling and placing a cover of 2 feet of soil. The TD 15 is underpowered and cannot effectively operate the scraper in the area where they are now working.

The replacement of the Caterpillar 977 crawler loader appears necessary at this time. A 150 horsepower crawler loader, which costs between $37,000 and $43,000, would be the proper size of unit to purchase. The existing equipment that is replaced could be kept for standby use.

The use of track type equipment appears to be working out satisfactorily Some time is lost in moving from one end of the site to the other but in general the units are working effectively. Track type units appear more feasible for use at the Great Falls site due to the large quantities of refuse and relative amounts of sharp metallic items.

ELIMINATING OLD OPEN DUMP SITES

The existing open dump sites which are considered inadequate should be abandoned. Dump sites to be abandoned are located at Neihart, Belt, Stockett, Sand Coulee, Ulm, Fort Shaw and Vaughn. Refuse dumped at these areas should be buried in trenches and the whole area should be graded for proper drainage. To prevent further dumping in the area, the access road to the area should be fenced off and signs installed indicating the location of the new site. Drawings showing the approved methods of burying refuse are shown in the appendix of this report. Periodic cleanup in the abandoned area may be necessary for a short period of time.

JUNK AUTOMOBILES IN CASCADE COUNTY

Junk automobile hulks usually originate from one of three sources: (1) abandoned vehicles left on public or private land, (2) do-it-yourself wreckers and (3) commercial wreckers. The automobile hulk represents the final remains of what was once licensed, taxed and classed as titled private property.

The number of licensed automobiles in Cascade County has tripled (from 12,588 to 37,032) in the last 20 years. Obviously the problems we have today are certain to multiply unless methods for suitable disposal are found.

A junk automobile survey conducted in Cascade County showed that more than 5,000 abandoned cars and trucks are located in back yards, streets, highways, rivers, creeks, and are scattered at random across the country side. These cars are usually stripped of tires, wheels, lights and other salvagable parts.

AUTOMOBILE
GRAVEYARDS

CASCADE COUNTY

AUTOMOBILE GRAVEYARD - CASCADE COUNTY

Over 5,900 automobiles are stored in junk yards throughout the county. A 9-acre area located near Great Falls is covered with old crushed auto hulks to a depth of about 10 feet. More than 500 auto hulks are placed along streams and rivers for use as riprap. The survey indicates that Cascade County does have a motor vehicle disposal problem.

From a national viewpoint auto hulks are a major raw material resource providing millions of tons of metals for resmelting. The scrap metal industry has been processing and selling automotive scrap for many years. However, in recent years there has been a decline in the scrap metal market because of changes in the methods of steel processing.

The scrap industry has its own terminology which is used to distinguish the different grades and types of automotive scrap. Scraps purchased as "number 2 bundle" can contain burned or hand stripped automobile bodies and fender stock which has been compressed to a size that will fit a furance. The unit weight of the bundle cannot be less than 75 pounds per cubic foot. These bundles are not to contain tin-coated, lead-coated or vitreous enameled material. Another classification "bundled number 2 steel" may contain, in addition to auto bodies, such parts as chassis, drive shafts and bumpers. "Automotive slab" is another type of steel scrap produced by shearing a compressed automobile hulk into slabs of desired dimensions. "Shredded scrap" is a grade of scrap especially suited for electric furnace melting. It consists of small pieces of fragmented automobile bodies ranging in size from 1/2 inch to 12 inches in length or width. "Number 2 heavy melting scrap" includes automotive parts such as frames, axles, springs, shock absorbers, wheels, transmissions, differentials, drive shafts, bumpers, brake shoes and steering linkages. Specifications governing the purchase of scrap consider the types of material contained in the bale as well as the physical size of the scrap.

The auto hulks must be stripped of all salvagable material as well as material not suitable for baling. Foreign matter in a certain class of bale affects the price received for the bale. After the car is stripped and the different classes of material segregated, the junk automobile is compressed into a bale as required by the market areas. An alternate to this would be a shredder which cuts up the material into small pieces.

Equipment for baling scrap can cost from $40,000 up to several hundred thousand dollars. Portable balers are available. Shredders that will handle automobile hulks are available from about $275,000 and up. Any equipment that is used for grinding, shredding or compacting large metallic items will obviously receive rough wear and require maintenance.

Some of the scrap markets located near Cascade County are: Seattle, Washington; Portland, Oregon; Geneva, Utah; Pueblo, Colorado; Regina, Saskatchewan, Canada; and Calgary, Alberta, Canada. Current prices on "number 2 bundles" vary from $15.00 to $23.00 per ton at the markets mentioned above. Seattle and Portland, at the time of this writing, were buying "number 2 bundles" at $23.00 per ton.

Freight rates from Great Falls to Portland or Seattle are currently $13.00 to $14.00 per ton. With a market value of $23.00 per ton and a freight cost of $14.00 per ton, only $9.00 per ton remains for obtaining and processing the junk automobile hulks, and it takes 2 to 3 stripped car bodies to make a ton of scrap. Obviously a scrap processor cannot obtain an abandoned car, strip it and bale or shred the hulk for $3.00 to $4.50 per car.

The definition of "rubbish" as used in Chapter 40 of the Revised Codes of Montana, dealing with refuse disposal areas, includes "abandoned automobiles...and similar materials". It would appear that at the present time a motor vehicle is considered to be "abandoned" when left on public highways, streets, roads or public property for more than 5 days. Once having been abandoned by this definition the automobile may be impounded and sold. However, it would not appear that sale of such a vehicle would necessarily result in a desirable form of disposal. The purchaser of such a vehicle would not be obliged to take any particular action with regard to the vehicle other than to take it from the storage facility of the city or county law enforcement officials conducting the sale. Such vehicles allowed to accumulate on private property are not within the definition of abandonment set forth in the act cited above dealing with abandoned vehicles. Certainly the provisions of Chapter 40 of Title 69 would provide some assistance in dealing with abandoned automobiles to the extent they are dumped in an unlicensed area. However, even that act expressly provides that it is not to be construed as prohibiting any person from disposing of rubbish (abandoned automobiles and similar materials) upon his own land as long as such disposal does not create a nuisance. Thus the scrap or junk dealer who accumulates car bodies on his own property would have to be dealt with on the basis that such dumping or disposal constitutes a nuisance. Before any lasting improvement can be expected, legislation would be required prohibiting the disposal of abandoned vehicles on private land. Existing statutes which require the licensing of refuse disposal areas could be expanded to require licensing of the areas to be used by scrap or junk dealers to store abandoned autos. Such dealers are now subject to certain screening requirements enacted in conjunction with our Interstate Highway system under Section 32-4514(4) but only if located within 1,000 feet from the edge of the right-of-way of a highway in the Interstate or primary systems.

Once suitable legislation is enacted, donated labor and equipment, combined with the effects of a county-wide collection agency, could proceed with cleaning up the country-side that is now littered with junk automobiles. Provisions would be made at each disposal site to crush and bury old car hulks.

RECORDS

The efficient management of any enterprise depends a great deal on proper control of men and materials. Part of this control is gained through detailed records on field data, equipment, administrative data and accidents. Records essential for solid waste information were discussed in Section VI of this report. These records are not only important for future design but are necessary for satisfactory management of continuing collection and disposal operations.

FINANCING

Initial Costs

Alternate 1- Includes rural routes with once per week collection and Great Falls with twice per week collection.

Alternate 2 - Includes rural routes with once per week collection and Great Falls with once per week collection.

Alternate 3 - Includes rural routes and the area adjacent to the Great Falls city limits with once per week collection. Under this alternate Great Falls would continue to operate its existing system and would not be included in the county-wide program.

The breakdown of initial costs is given in Tables 7 & 8. Alternates 1, 2, and 3 show initial costs of $632,000, $520,000 and $174,000, respectively. The final determination of whether to use Alternate 1, 2, or 3 will depend on Great Falls' participation in the program and the frequency of collection in the Great Falls area.

Operation, Maintenance and Replacement Costs

Upon initiation of the Cascade County-wide program, it will be necessary to obtain funds for operating maintaining and administrating the program. The yearly depreciation on all the equipment and landfill sites has been included in the costs shown in Table 11. Deposits made periodically into a sinking fund would be available in the future for replacement of the equipment and purchase of land. Table 8 shows the years of depreciation allowed for each item of capital outlay. All replacement costs are based on no salvage value at the end of the period. Replacement costs for land and heavy equipment are based on a 5 per cent increase per year, and for trucks are based on a 3 per cent increase per year. Landfill operation and maintenance costs are shown in Table 9 for two different alternates - one including the entire county and the other including the rural portion of the county and the fringe areas of Great Falls. The table is self-explanatory and gives the costs for only the major items required for landfill maintenance and operation. An allowance has been made for supplies required at landfills.

Collection Costs

Collection costs are shown in Table 10. Hourly rates are computed for collection vehicles complete with crews. A basic wage rate was expanded to include administrative costs and overhead. By combining truck and labor costs, 1968 total hourly costs were determined for 2-man and 3-man crews operating an 18 cubic yard vehicle. The total number of hours required for collection per year was then determined for the different collection areas. Total collection costs were computed and used in Table 11 to determine the cost per dwelling.

Summary of Operation, Maintenance and Replacement Costs

From Table 2 it is possible to determine the tons of refuse produced per year for each area, and thereby calculate the cost per ton of refuse. Approximately 73 per cent of the total revenue collection in Great Falls is from residential services and 27 per cent is from commercial services. Using the data shown in Table 2, and 3.2 people per dwelling, the refuse production is calculated to be 1.84 tons per dwelling per year. The actual refuse from each home is somewhat lower because the refuse from commercial services was not deducted. The cost per ton of refuse collected is $26.46. Of this cost 73 per cent ($19.32 per ton) or a total cost of $36.00 per year, is to be paid by each residential service per year. This rate would apply to Alternate 1 which includes twice per week collection in Great Falls and once per week collection in the rural areas.

Alternate 2, which is for once per week collection in all areas, would cost an average of $24.00 per residential service per year.

Since the majority of the commercial establishments in Cascade County are located in Great Falls, which is excluded from Alternate 3, the cost per ton for collection and disposal for Alternate 3 is based on 100 per cent residential revenue. Using 3.2 people per dwelling and the rural population given in Table 2, the cost is $36.00 per residential dwelling per year.

Application for a demonstration project grant may be considered as one method of obtaining funds to initiate an organized system of collection and disposal of refuse throughout Cascade County. The Solid Waste Disposal Demonstration Project Grants are authorized by the Solid Waste Disposal Act - Public Law 89-272 which provides for Federal grants for new and improved methods, practices, programs and techniques of solid waste disposal.

RATES

Residential Rates

The most accurate method of paying for any service is on a quantity basis. Each family would pay for the exact amount of refuse it discards, as measured on a weight or volume basis. Obviously collection crews cannot take the time to weigh the refuse discarded from each home and keep records of these amounts. The bookkeeping would be costly and subject to error.

It appears that the flat rate method of assessment for refuse collection and disposal for residential services is one of the most practical means of obtaining revenue. Variations can be made to allow the smaller dwellings a rate reduction, while the larger dwellings would pay an increased rate over and above the average flat rate.

The City of Great Falls has based the residential charge rates on the number of rooms in each home. To a limited degree, the number of people and the amount of refuse varies with the number of rooms. To simplify accounting procedures, we recommend that only 3 charge rates be used for residential services. Separate rates would be charged for homes with 3 rooms and under, for homes with 4 and 5 rooms, and for homes with 6 rooms and over.

Vacant Charges

Owners of rental property should be required to pay the standard rate specified whether their units are vacant or occupied. Once or twice a year the owner could report and sign an affidavit that the rental unit was empty during a certain period of time. Refunds could be made after necessary checking to verify that the unit was vacant. This would eliminate the situation where the owner has the collection fee discontinued because his unit is vacant and then conveniently forgets to inform the city that he has rented the unit again. The collection crew is often unable to determine when a new service is placed out for collection, particularly in multi-family dwellings.

Commercial Rates

Commercial rates for refuse collection and disposal should vary with the quantities of refuse produced and the type of containers used. Bulk containers are much easier to dump than several small containers of equal total volume. Obviously pickup time and refuse quantities are both matters to be considered in figuring the cost per commercial service.

In order to rate each commercial service on a time and quantity basis, it is necessary to determine the time required for the crew to collect the refuse, and the volume of refuse collected should be estimated. After several observations have been made at each service, it is possible to determine an equitable charge for each commercial service. This field data should be obtained under the direction of a superintendent of the Sanitation Department.

AUTHORITY FOR COUNTY-WIDE PROGRAM

There are certain legal matters connected with the organization of a Cascade County-wide program for regulation of storage, collection and disposal of solid wastes. The primary concern is whether or not there is existing legislation allowing for the establishment of such a county-wide program and, if so, what type of organization can be set up to control the system.

A legal review of existing statutes has brought out some uncertainties involving the basic power of agencies of the executive branches of state and local governments, as well as the basic relationship of county and city governmental agencies.

One of the basic problems with existing legislation is the absence of any concentrated authority for implementation of a county-wide solid waste disposal program in any single governmental entity. At the present time cities, towns and counties are equipped to deal with the problem on only a piecemeal basis. The local Board of Health, particularly where such local board is a city-county board of health, is the logical entity for actual regulation and conduct of the contemplated program.

In order to eliminate any question about the jurisdiction of local boards of health, it is recommended that Chapter 45 of Title 69 of the Revised Codes of Montana be amended to affirmatively state what is believed to be the current law, namely, that the jurisdiction of county boards of health extends to all incorporated cities and towns within the boundaries of the county which are of less than second class. Cities of first and second class may have a separate board of health and are empowered to, by mutual agreement, unite with the county in a city-county board of health under Section 69-4506 of the Revised Codes of Montana.

The powers of local boards of health set forth in Section 69-4509 (2) should then be expanded to allow establishment by such local boards of a comprehensive system of regulation governing the collection, storage, transportation and disposal of garbage, refuse and rubbish as these terms are defined in Section 69-4002 (relating to solid waste disposal areas). Such a provision should further authorize in conjunction with the establishment of such a system the creation and maintenance of an exclusive collection service throughout the area subject to the board's jurisdiction or in such portions thereof as in the discretion of the board would best serve the health of the area's residents. Further provision would be made to provide this service on a fee basis to be conducted by board employees or contract collectors licensed by the board, or both. The board should be authorized to utilize the facilities of the respective offices of the city and county treasurers for collection of the service fees.

In order to finance the initial acquisition of land for disposal sites and the equipment necessary to maintain these sites and provide the collection and service needed, the board should further be given the power to establish a garbage, refuse and rubbish district encompassing the area of its jurisdiction. This power would be exercised pursuant to a more detailed district provision in the nature of that found currently in Section 16-1031 providing for establishment of garbage and ash collection in certain areas of a county.

The district provision established (perhaps by amendment of Section 16-1031) should provide for creation of the district upon resolution of the local board of health and perhaps, in the alternative, the county commissioners, but nevertheless subject to the regulation and supervision of the collection, storage, transportation and disposal of waste by the local board of health. Some provision for notice of creation of the district and of its levies or assessments would have to be made with an opportunity for hearing of protestants prior to collection of any assessment. If the present Section 16-1031 were attempted to be utilized, it would be necessary to eliminate the current prohibition against dual use of fee for service and levy as sources of revenue. It would appear to be necessary under the program contemplated to utilize a combination of these two sources to equitably fund a county-wide program.

The local board of health should also be empowered to employ such personnel as required to supervise and operate the comprehensive system contemplated. In addition, the rule-making power of the local board found in Section 69-4509 (2)(j)(ii) should be broadened to include rules for regulation of collection, storage, transportation and disposal of garbage, refuse and rubbish.

TABLE 1
CASCADE COUNTY POPULATION PROJECTION TO 1988 *

	1960	Projections for 1968			Projections for 1988		
City or Town	Census	A	B	C	A	B	C
Great Falls	55,244	---	---	76,000	---	---	136,000
Vaughn	265	331	342	335	527	535	530
Sun River	100	112	103	110	134	110	125
Fort Shaw	100	112	109	110	134	131	130
Simms	200	224	198	210	268	193	240
Ulm	350	438	335	415	696	297	665
Cascade	604	755	652	730	1,202	773	1,140
Tracy	170	212	149	200	338	96	320
Sand Coulee	300	375	262	350	597	168	565
Stockett	400	500	350	475	796	225	755
Centerville	85	106	75	90	169	49	150
Monarch-Winter	(20)	(22)	(31)	(27)	(27)	(58)	(45)
Monarch-Summer	(150)	(168)	(230)	(170)	(201)	(429)	(220)
Neihart	150	168	54	170	201	0	220
Belt	757	946	723	900	1,506	639	1,430
Totals	58,810			80,193			142,403

A . Based on "Great Falls Urban Transportation Survey" 1961, Volume IV, and United States Census of Population, Bureau of Census, U.S. Dept. of Commerce, and "Commercial Atlas and Marketing Guide", 98th Edition, 1967, printed by Rand McNally & Co.

B. Based on School District census material taken from 1960 - 1967. School census trends were extrapolated for projections of the towns after correlating 1960 school census to 1960 town population.

C. Population used for this study.

* Data obtained from Great Falls City-County Planning Board

TABLE 2
REFUSE COLLECTION QUANTITIES

					CY/Wk. Packed	
	1968		1988		1968	1988
City or Town	A	B	A	B	C	D
Great Falls	76,000	*76,000	136,000	*136,000	2,795.0	7,000.0
Adjacent Gt. Falls	---	4,000	---	6,000	147.0	309.0
Vaughn	335	370	530	580	13.9	29.9
Sun River	110	120	125	135	4.7	7.2
Fort Shaw	110	120	130	145	4.7	7.7
Simms	210	230	240	265	8.8	13.9
Ulm	415	455	665	730	17.0	37.6
Cascade	730	800	1,140	1,250	29.3	64.3
Tracy	200	220	320	350	8.3	18.0
Sand Coulee	350	385	565	620	14.4	32.0
Stockett	475	520	755	830	19.0	42.7
Centerville	90	100	150	165	3.6	8.8
Monarch-Winter	(27)	(30)	(45)	(50)	1.0	2.6
Monarch-Summer	(170)	(185)	(220)	(240)	6.7	12.4
Neihart	170	185	220	240	6.7	12.4
Belt	900	990	1,430	1,570	36.5	80.7
Total	80,193	*84,603	142,403	*149,025	3,112.8	7,672.0
Total-Cascade Co.	91,800	91,800	153,000	153,000		

A . Population projection from Table 1.

B . Town population increased to allow for total population on collection route. Great Falls city limit and adjacent population listed separately

C . Refuse collection (1968) = 2.5 lbs./cap./day. Loose weight = 350lbs./Cu. Yd. Volume of packed = .735 times volume of loose

D. Refuse collection (1988) = 3.5 lbs./cap.day. Loose weight = 350 lbs./Cu.Yd. Volume of packed = .735 times volume of loose

* 3,530 people living on Malmstrom Air Force Base dispose of waste at the base disposal site and are not included.

TABLE 3
SANITARY LANDFILL VOLUMES REQUIRED FOR 1968-1988

City or Town	A	Acre Feet B
Great Falls	106,000	2,740.0
Adjacent Great Falls	5,000	129.0
Vaughn-Ulm	1,068	27.5
Sun River, Simms & Fort Shaw	509	13.1
Cascade	1,025	26.5
Tracy, Sand Coulee, Stockett & Centerville	1,596	41.1
Monarch-Neihart	339	8.8
Belt	1,280	33.0

A. 1968 and 1988 populations on collection routes (Table 2) averaged to give 20 year overall average for each area.

B. Sanitary landfill volume required for 20 year design period (1968-1988) using average refuse production rate of 5.6 lbs./cap./day and a compacted landfill refuse density of 1,000 lbs./cu.yd;· 1.29 acre feet of land required per year per 1,000 people.

TABLE 4

1968 COUNTY-WIDE COLLECTION ROUTING (EXCLUDING GREAT FALLS)

EASTERN ROUTE

City or Town	Mileage Between Areas	Highway Travel Time A	Amount of Packed Refuse Produced Per Week B	Once Week Pickup Time 2-Man Crew C	Twice Week Pickup Time 2-Man Crew D
Belt			----		
	20	55 min.			
Tracy-Sand Coulee			23 CY = 5.05 ton	5 hr. 40 min.	9 hr. 30 min.
	5	15 min.			
Centerville-Stockett			23 CY = 5.50 ton	5 hr. 40 min.	9 hr. 30 min.
	24	60 min.			
Belt			----		
	38	135 min. (Uphill)			
Neihart			7 CY = 1.54 ton	1 hr. 44 min.	2 hr. 54 min.
	13	30 min. (Downhill)			
Monarch			7 CY = 1.54 ton	1 hr. 44 min.	2 hr. 54 min.
	25	60 min. (Downhill)			
Belt			37 CY = 8.14 ton	9 hr. 10 min.	15 hr. 19 min.
TOTALS	125	5 hr. 55 min.		23 hr. 58 min.	40 hr. 7 min.

A,B,C, D: See typical footnotes for Tables 4 and 5 Page 144

TABLE 4

1968 COUNTY-WIDE COLLECTION ROUTING (EXCLUDING GREAT FALLS)

WESTERN ROUTE

City or Town	Mileage Between Areas	Highway Travel Time A	Amount of Packed Refuse Produced Per Week B	Once Week Pickup Time 2-Man Crew C	Twice Week Pickup Time 2-Man Crew D
Vaughn			14 CY = 3.08 ton	3 hr. 28 min.	5 hr. 48 min.
	10 (Gravel)	45 min.			
Ulm			17 CY = 3.74 ton	4 hr. 13 min.	7 hr. 3 min.
	14	40 min.			
Cascade			29 CY = 6.39 ton	7 hr. 11 min.	12 hr. 5 min.
	20 (Gravel)	60 min.			
Ft. Shaw			5 CY = 1.1 ton	1 hr. 15 min.	2 hr. 5 min.
	6	15 min.			
Simms			9 CY = 1.98 ton	2 hr. 14 min.	3 hr. 44 min.
	10	30 min.			
Sun River			5 CY = 1.1 ton	1 hr. 15 min.	2 hr. 5 min.
	9	25 min.			
Vaughn			----		
TOTALS	69	3 hr. 35 min.		19 hr. 36 min.	32 hr. 50 min.

A, B, C, D: See typical footnotes for Tables 4 and 5. Page 144

TABLE 4

1968 COUNTY-WIDE COLLECTION ROUTING (GREAT FALLS)

City or Town	Mileage Between Areas	Highway Travel Time A	Amount of Packed Refuse Produced Per Week B	Crew Size	Once Week Pickup Time as per crew size C	Twice Week Pickup Time as per crew size D
Great Falls Rural	20	50 min.	147 CY = 32.3 ton	2	36 hr. 20 min.	60 hr. 50 min.
Great Falls Rural	20	50 min.	147 CY = 32.3 ton	3	24 hr. 14 min.	40 hr. 33 min.
Great Falls City Limits	0	0	2795 CY = 615 ton	3	341 hr. 40 min.	571 hr. 7 min.

A, B, C, D : See typical footnotes for Tables 4 and 5. Page 144

TABLE 5

1988 COUNTY-WIDE COLLECTION ROUTING (EXCLUDING GREAT FALLS)

EASTERN ROUTE

City or Town	Mileage Between Areas	Highway Travel Time A	Amount of Packed Refuse Produced Per Week B	Once Week Pickup Time 2-Man Crew C	Twice Week Pickup Time 2-Man Crew D
Belt			----		
	20	55 min.			
Tracy-Sand Coulee			50 CY = 11.0 Ton	12 hr. 23 min.	20 hr. 43 min.
	5	15 min.			
Centerville-Stockett			52 CY = 11.45 ton	12 hr. 56 min.	21 hr. 34 min.
	24	60 min.			
Belt			81 CY = 17.8 ton	20 hr. 0 min.	33 hr. 30 min.
	25	90 min. (Uphill)			
Monarch			12 CY = 2.63 ton	2 hr. 58 min.	4 hr. 57 min.
	13	45 min. (Uphill)			
Neihart			13 CY = 2.86 ton	3 hr. 13 min.	5 hr. 23 min.
	38	90 min. (Downhill)	----		
Belt					
TOTALS	125	5 hr. 55 min.		51 hr. 30 min.	86 hr. 7 min.

A, B, C, D: See typical footnotes for Tables 4 and 5. Page 144

TABLE 5

1988 COUNTY-WIDE COLLECTION ROUTING (EXCLUDING GREAT FALLS)

WESTERN ROUTE

City or Town	Mileage Between Areas	Highway Travel Time A	Amount of Packed Refuse Produced Per Week B	Once Week Pickup Time 2-Man Crew C	Twice Week Pickup Time 2-Man Crew D
Vaughn			30 CY = 6.6 ton	7 hr. 25 min.	12 hr. 26 min.
	10 (Gravel)	45 min.			
Ulm			38 CY = 8.36 ton	9 hr. 25 min	15 hr. 45 min.
	14	40 min.			
Cascade			65 CY = 14.3 ton	16 hr. 5 min.	26 hr. 55 min.
	20 (Gravel)	60 min.			
Ft. Shaw			8 CY = 1.76 ton	1 hr. 59 min.	3 hr. 19 min.
	6	15 min.			
Simms			14 CY = 3.08 ton	3 hr. 28 min.	5 hr. 49 min.
	10	30 min.			
Sun River			7 CY = 1.54 ton	1 hr. 44 min.	2 hr. 54 min.
	9	25 min.			
Vaughn			----		
TOTALS	69	3 hr. 35 min.		40 hr. 6 min.	67 hr. 8 min.

A, B, C, D: See typical footnotes for Tables 4 and 5. Page 144

TABLE 5

1988 COUNTY-WIDE COLLECTION ROUTING (GREAT FALLS)

City or Town	Mileage Between Areas	Highway Travel Time A	Amount of Packed Refuse Produced Per Week B	Crew Size	Once Week Pickup Time as per crew size C	Twice Week Pickup Time as per crew size D
Great Falls Rural	20	50 min.	309 CY = 68 ton	2	76 hr. 30 min.	128 hr. 10 min.
Great Falls Rural	20	50 min.	309 CY = 68 ton	3	51 hr. 0 min.	85 hr. 27 min.
Great Falls City Limits	0	0	7000 CY = 1,540 ton	3	855 hr. 33 min.	1428 hr. 47 min.

A, B, C, D : See typical footnotes for Tables 4 and 5.

Typical Footnotes for Tables 4 and 5:

A. 25 mph average truck speed on level grades with adjustment for other grades accordingly.
B. 475 pounds/cubic yard for packed refuse in a mechanical packer collection vehicle. See Table 2.
C. 135 man minutes/ton for once/week collection and 226 man minutes/ton for twice/week collection.
D. Does not include haul time to and from disposal sites. Also does not include pickup time for areas other than those listed. Does not include time for lunch, coffee breaks, etc.

TABLE 6

SANITARY LANDFILL AREAS AND VOLUMES REQUIRED

City or Town	Existing Area Acres	Estimate of Area left for Future Use	Vol. Required for 20 yrs. See Table 3	20 Year Area Required (Acres)	Additional Area Required	Years Future Use From Existing Site	Landfill Recommendation
Monarch and Neihart	1.5 acres	0.7 acres	9 acre feet	with 6' depth 1.5 acres	0.8 acres	9 years	Enlarge Existing Site
Belt	3.1 acres	0.4 acres	33 acre feet	with 6' depth 5.5 acres	5.5 acres	1.5 years	Locate New Site
Stockett-Centerville-Sand Coulee-Tracy	± 3.6 acres ± 5.0 acres	None Recommended	41 acre feet	with 8' depth 5.1 acres	5.1 acres	-0-	Locate New Site
Great Falls Proper	Leased 105 acres	50 acres	2740 acre feet	with 20' depth 137 acres	87 acres	7 years	Obtain Adjacent Land
Great Falls Rural	-0-	-0-	129 acre feet	with 6' depth 22 acres	22 acres	No existing Site	Locate New Site
Ulm Vaughn	0.8 acres 0.5 acres	0.2 acres 0.2 acres	28 acre feet	with 6' depth 4.7 acres	4.7 acres	1 year	Locate Site
Cascade	3.8 acres	2.3 acres	27 acre feet	with 6' depth 4.5 acres	2.2 acres	10 years	Enlarge Existing Site
Sun River-Fort Shaw & Simms	3.4 acres	None Recommended	13 acre feet	with 6' depth 2.2 acres	2.2 acres	-0-	Locate New Site

TABLE 7

SUMMARY OF INITIAL COSTS

ALTERNATE 1

Initial Costs Including Great Falls - Twice per Week Pickup

Landfill sites and implementation	$250,000
Landfill equipment - rural	$ 42,000
Collection vehicles - rural (2 units @ $15,000 each)	$ 30,000
Landfill equipment - Great Falls	$ 86,000
Collection equipment - Gt. Falls (16 units @ $14,000 ea.)	$224,000
	$632,000

ALTERNATE 2

Initial Costs Including Great Falls - Once per Week Pickup

Landfill sites and implementation	$250,000
Landfill equipment - rural	$ 42,000
Collection vehicles - rural (2 units @ $15,000 each)	$ 30,000
Landfill equipment - Great Falls	$ 86,000
Collection equipment - Gt. Falls (8 units @ $14,000 ea.)	$112,000
	$520,000

ALTERNATE 3

Initial Costs Excluding Great Falls - Once per Week Pickup

Landfill sites and implementation	$ 87,000
Landfill equipment	$ 42,000
Collection vehicles - (3 units @ $15,000 each)	$ 45,000
	$174,000

TABLE 8

REPLACEMENT OF CAPITAL OUTLAY FOR LAND AND LANDFILL EQUIPMENT (EXCLUDING COLLECTION COST)

Item	Initial Cost 1968	Years Depreciation	Replacement Cost After Period of Depreciation	D
Landfill sites implementation costs	$250,000 $87,000 (E)	20	$500,000 (A) $174,000 (E)	$15,120 $5,262 (E)
Wheel Loader & multi-purpose bucket	$31,000	5	$38,750 (B)	$7,013
Truck, trailer and accessories for transportation loader	$11,000	6	$12,980 (C)	$1,908
Crawler loader for Gt. Falls North	$43,000	5	$53,750 (B)	$9,727
Gt. Falls existing equipment	-0-	8	$80,000	$8,378
Crawler loader for Gt. Falls South	$43,000	5	$53,750 (B)	$9,727
TOTALS				$51,873 $14,183 (E)

A. Rising cost of land figured at 5% per year - does not include salvage value of filled land.
B. Rising cost of equipment figured at 5% per year.
C. Rising cost of trucks figured at 3% per year.
D. Yearly deposit required to obtain replacement cost after given years depreciation using 5% interest rate.
E. Excludes Great Falls sites.

TABLE 9

LANDFILL OPERATION AND MAINTENANCE COSTS

Operating Costs - Annual	Incl. Great Falls	Rural Only
Payroll - Great Falls		
2 equipment operators @ $650/mo.	$15,600	-----
Payroll - Rural		
1 equipment operator @ $650/mo.	$ 7,800	$ 7,800
Total Labor Per Year	$23,400	$ 7,800
Plus 20% for vacation, sick leave, retirement, etc.	$28,080	$ 9,360
Plus 20% for supervision & administration overhead TOTAL	$33,700	$11,230
Equipment Maintenance - Annual		
Great Falls -(140 hrs./wk)(50 wks.)(50¢ hr.)	$ 3,500	-----
Rural - (40 hrs./wk)(50 wks.)(50¢ hr.)	$ 1,000	$ 1,000
TOTAL	$ 4,500	$ 1,000
Supplies Necessary for Landfill Maintenance		
Great Falls	$ 1,000	-----
Rural	$ 3,000	$ 3,000
TOTAL	$ 4,000	$ 3,000
TOTAL PER YEAR FOR LANDFILL OPERATION & MAINTENANCE COSTS	$42,200	$15,230

TABLE 10

COLLECTION COSTS

LABOR COSTS PER HOUR

Basic wage rate for collection crew member	$3.50	
Plus 20% for vacation, sick leave, retirement, etc.	$4.20	
Plus 20% for supervision & administration overhead	$5.04	
Total hourly labor cost per man (for this study)		$5.05

VEHICLE COSTS PER HOUR

Initial cost of 4-ton payload vehicle	$14,000.00	
Amortization cost - per hour	$1.37 *	
Operation & maintenance cost - per hour	$2.50	
	$3.87	
Total hourly vehicle cost (for this study)		$3.90

TOTAL VEHICLE AND LABOR COSTS

	2-man Truck	3-man Truck
Total vehicle cost per hr. (4-ton unit)	$3.90	$3.90
Labor cost per hour	$10.10	$15.15
Total hourly cost (1968)	$14.00	$19.05

YEARLY WORKING HOURS (1968) (Using 9 holidays per year)

Great Falls: (40 hrs./wk.)(52 wks./yr.) - 72 hrs. = 2,008 hrs./yr.

Rural: (32 hrs./wk.)(52 wks./yr.) - 72 hrs. = 1,592 hrs./yr.

Great Falls Metropolitan Area (3-man crew - twice per wk. pickup)
(21 trucks)(2,008 hrs.) = 42,168 hrs./yr.

Rural Area (2-man crew - once per wk. pickup)
(2 trucks)(1,592 hrs.) = 3,184 hrs./yr.

Great Falls Metropolitan Area (3-man crew - once per wk. pickup)
(13 trucks)(2,008 hrs.) = 26,100 hrs./yr.

Rural Area Only, excluding Great Falls inside city limits (2-man crew - once per wk. pickup)
(3 trucks)(1,592 hrs.) = 4,776 hrs./yr.

* Amortization based on 6 years without interest or salvage value. Replacement cost increase based on 3%/yr.

TABLE 10 (CONTINUED)

ANNUAL COLLECTION COSTS

Alternate 1

Metropolitan Great Falls Area - (42,168 hrs./yr.)($19.05/hr.) = $803,300
Rural Area - (3,184 hrs./yr.)($14.00/hr.) = $ 44,576

TOTAL $847,876

Alternate 2

Metropolitan Great Falls Area - (26,100 hrs./yr.)($19.05/hr.) = $497,205
Rural Area - (3,184 hrs./yr.)($14.00/hr.) = $ 44,576

TOTAL $541,781

Alternate 3

Rural Area - (4,776 hrs./yr.)($14.00/hr.) = $66,864

TOTAL $66,864

TABLE 11

SUMMARY OF OPERATION, MAINTENANCE AND REPLACEMENT COSTS

ALTERNATE 1

Replacement of land and landfill equipment	(Table 8)	$51,873/yr.
Landfill operation and maintenance	(Table 9)	$42,200/yr.
Collection costs incl. vehicle replacement	(Table 10)	$847,876/yr.
	TOTAL	$941,949/yr.

Cost per ton produced $\dfrac{\$941,949}{35,600 \text{ ton/yr.}} = \$26.46\text{/ton}$

$26.46/ton x 73%* = $19.32/ton for residential dwelling

$19.32/ton x 1.84** ton/res.dwelling/yr. = $35.55/res.dwelling/yr.

ALTERNATE 2

Replacement of land and landfill equipment	(Table 8)	$51,873/yr.
Landfill operation and maintenance	(Table 9)	$42,200/yr.
Collection costs incl. vehicle replacement	(Table 10)	$541,781/yr.
	TOTAL	$635,854/yr.

Cost per ton produced $\dfrac{\$635,854}{35,600 \text{ ton/yr.}} = \$17.86\text{/ton}$

$17.86/ton x 73%* = $13.04/ton for residential dwelling

$13.04/ton x 1.84** ton/res. dwelling/yr. = $24.00/res.dwelling/yr.

ALTERNATE 3

Replacement of land and landfill equipment	(Table 8)	$14,183/yr.
Landfill operation and maintenance	(Table 9)	$15,230/yr.
Collection costs incl. vehicle replacement	(Table 10)	$66,864/yr.
	TOTAL	$96,277/yr.

Since commercial firms are a small percentage of total rural services, rates are based on residential charges.

Total cost per dwelling: $\dfrac{\$96,277}{2,690 \text{ dwellings}} = \$35.79\text{/res/dwelling/yr.}$

* For the City of Great Falls, 73% of the total revenue is from residential billing and the remaining 27% is from commercial

** Obtained by dividing the total refuse produced by the total number of residential dwellings

TABLE 12

FIELD DAILY REPORT

SAMPLE

1	2	3	4	5	6	7	8
6/20/69	Ft. Shaw	8:10 A.M.	10:20 A.M.	15 min. break	Ft. Shaw site Est. 8 CY Packer Truck	Household Refuse	Issued warning to Ft. Shaw resident re: rocks in refuse container
6/20/69	Simms	10:50 A.M.	3:20 P.M.	60 min. Lunch	Ft. Shaw site Est. 14 CY Packer Truck	Household & 30% yard trim	---

Column

1. Date of pickup
2. Location of routes. Keep current on area map also.
3. Time started each loading operation on each portion of route.
4. Time completed each loading operation on each portion of route.
5. If loading time is interrupted by lunch, coffæbreaks, vehicle breakdowns, etc., the length of time should be indicated here. Column 4 less Column 3 should be actual loading time only.
6. Location of disposal site used and quantity of refuse (cubic yards or weight) collected. If no weight scales are available, estimate % truck full and mark down in volume.
7. Type of refuse collected as household waste, yard trimmings, paper cartons, etc. Estimate percent of each.
8. Record any complaints made to you by residents or any warnings made by crew to violators of ordinance. Note vehicle breakdowns and other pertinent information.

DEFINITIONS

Refuse	All putrescible and nonputrescible solid wastes, (except body wastes), including garbage, rubbish, ashes, street cleanings, dead animals, abandoned automobiles, and solid market and industrial wastes.
Garbage	Putrescible animal and vegetable wastes resulting from the handling, preparation, cooking and consumption of food.
Rubbish	Nonputrescible solid wastes, including ashes, consisting of both combustible and noncombustible wastes, such as paper, cardboard, tin cans, yard clippings, wood, glass, bedding, crockery, metals, dirt and similar materials.
Ashes	Residue from the burning of wood, coal, coke, refuse or other combustible materials.
Industrial Refuse	All solid wastes which result from industrial processes and manufacturing operations such as factories, processing plants, repair and cleaning establishments, refineries and rendering plants.
Swill	Semi-liquid waste material consisting of garbage and free liquids.
Commercial Refuse	All solid wastes produced by businesses such as office buildings, stores, markets, theaters, and privately owned hospitals and other institutional buildings.
Disposal Area	A site, location, tract of land, area, building, structure or premises used or intended to be used for partial and/or total refuse disposal.
Domestic Refuse	All the refuse, excluding garbage, which normally originates in a residential household or apartment house.
Mixed Domestic Refuse	Includes domestic refuse and garbage.
Incineration	The process of burning solid, semisolid, or gaseous combustible wastes to an inoffensive gas and a sterile residue containing little or no combustible material.
On-site Disposal	Includes all means of disposal or, more usually, volume reduction, of refuse on premises before collection. Examples are garbage grinding; burning or incineration; burial; compaction; or slurrying at homes and commercial establishments.

Particulate Matter	Any liquid or any solid which is so finely divided as to be capable of becoming windblown or being suspended in air or gas.
Putrescible	Capable of being decomposed by micro-organisms with sufficient rapidity as to cause nuisances from odors, gases, etc. Kitchen wastes, offal, and dead animals are examples of putrescible components of solid wastes.
Vector	An organism, usually an insect, which carries and transmits disease causing microorganisms.
Refuse Producer	Any firm, establishment, group of persons or person that produces, obtains or has any refuse for disposal. Includes residential homeowners and commercial firms.
Abandoned or Junk Vehicles	Unwanted non-operable passenger automobiles, trucks, and trailers that are no longer useful as such and have been left on city streets, public areas, river banks or on private land.
Sanitary Landfill	A method of disposing of refuse on land without creating nuisances or hazards to public health or safety, by utilizing the principles of engineering to confine the refuse to the smallest practical area, to reduce it to the smallest practical volume, and to cover it with a layer of earth at the conclusion of each day's operation or at such more frequent intervals as may be necessary.

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- Monarch 3
- Neihart 4
- Sand Coulee and Tracy - 2 sheets 5
- Stockett & Centerville 6
- Sun River, Fort Shaw and Simms 7
- Ulm 8
- Vaughn 9
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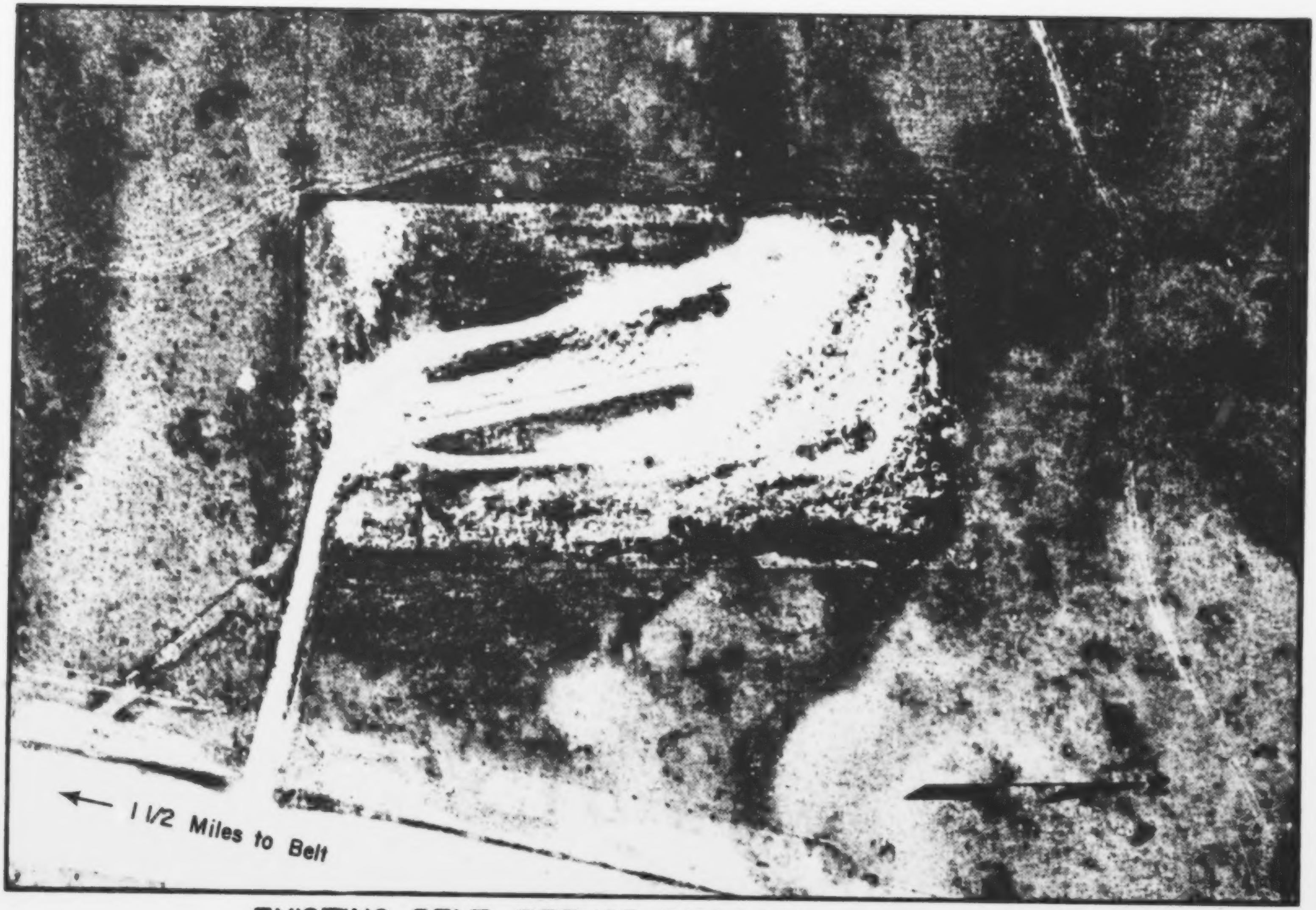
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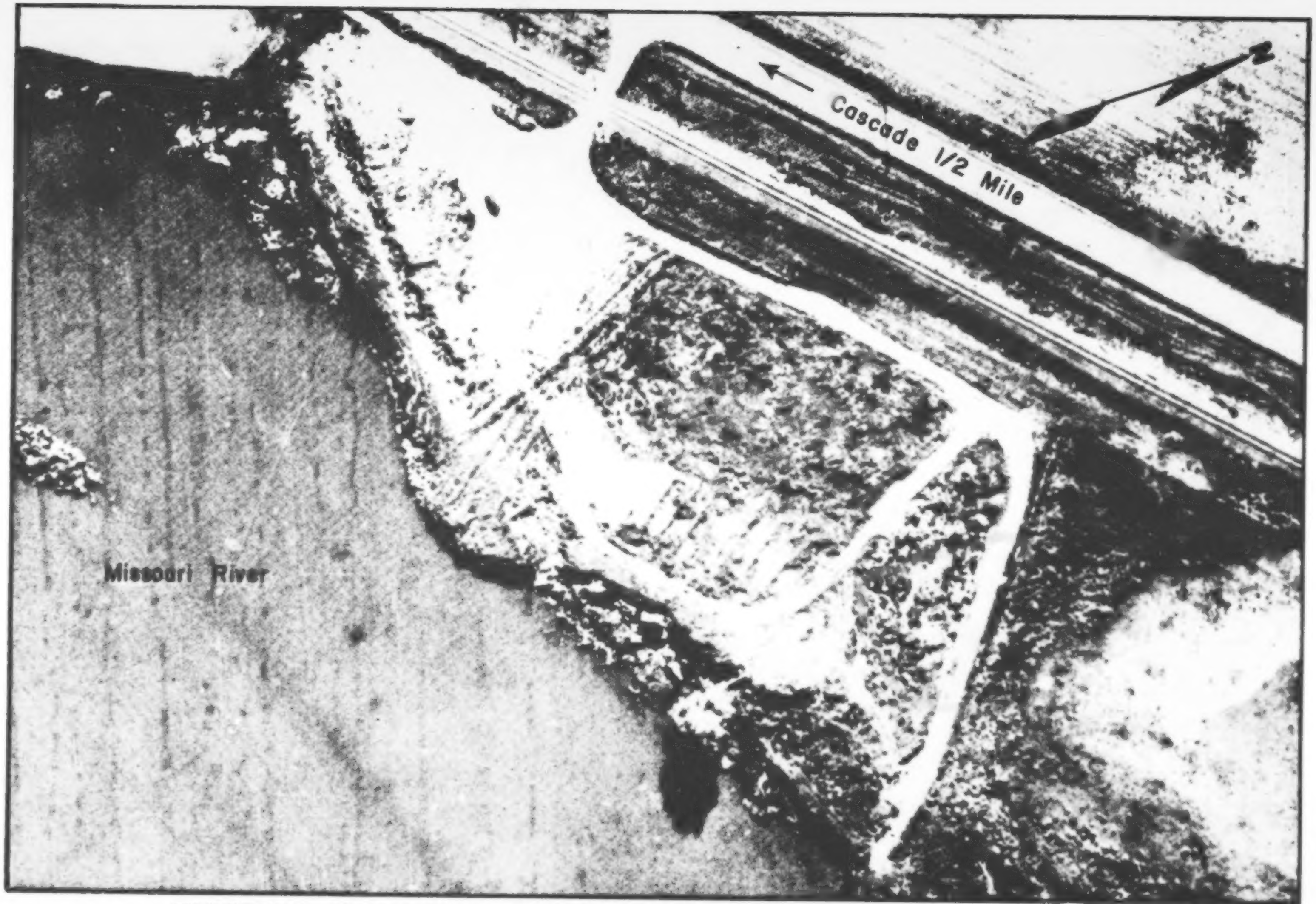
EXISTING BELT REFUSE DISPOSAL AREA Exhibit #1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Missouri River

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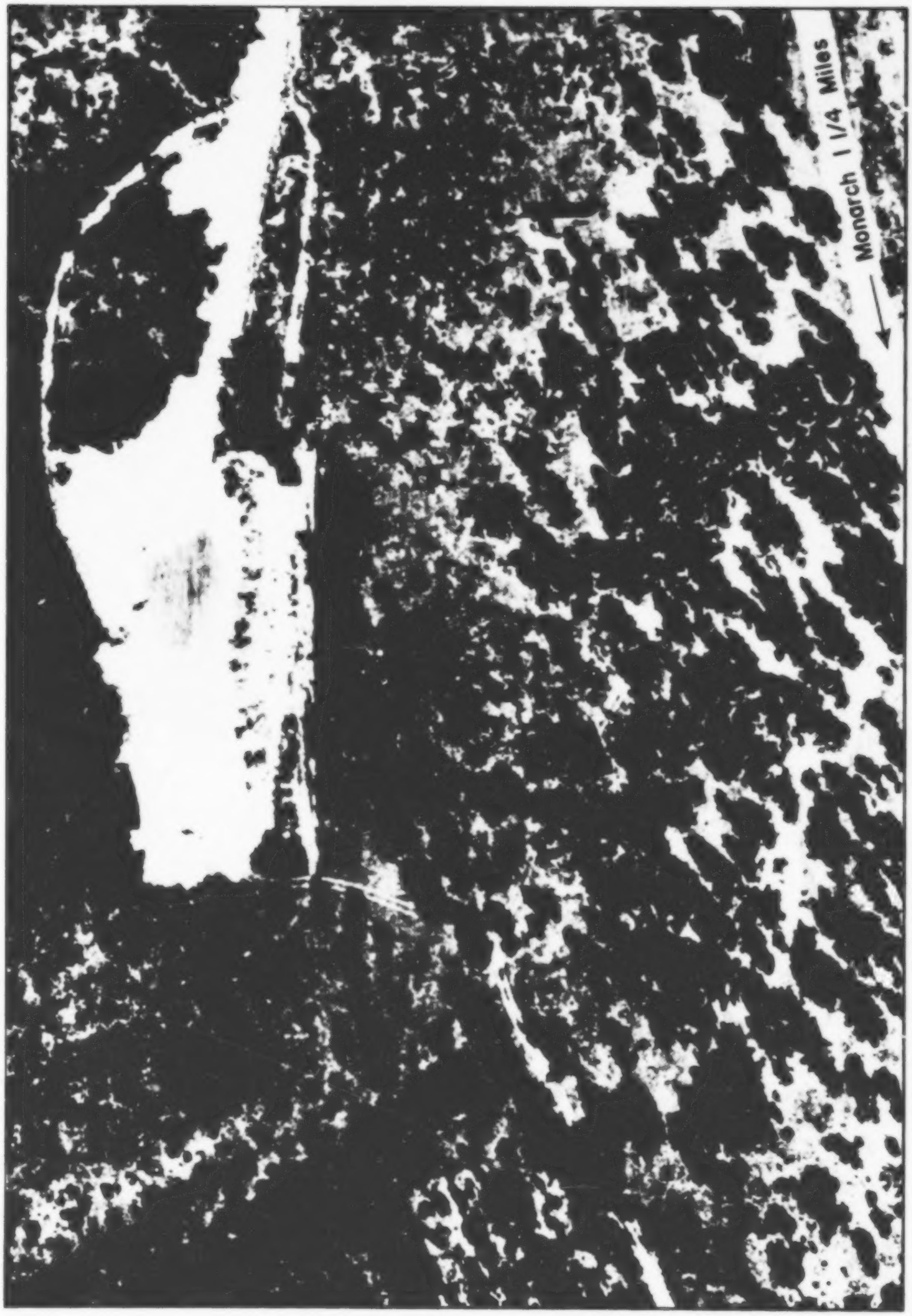
Monarch 1 1/4 Miles

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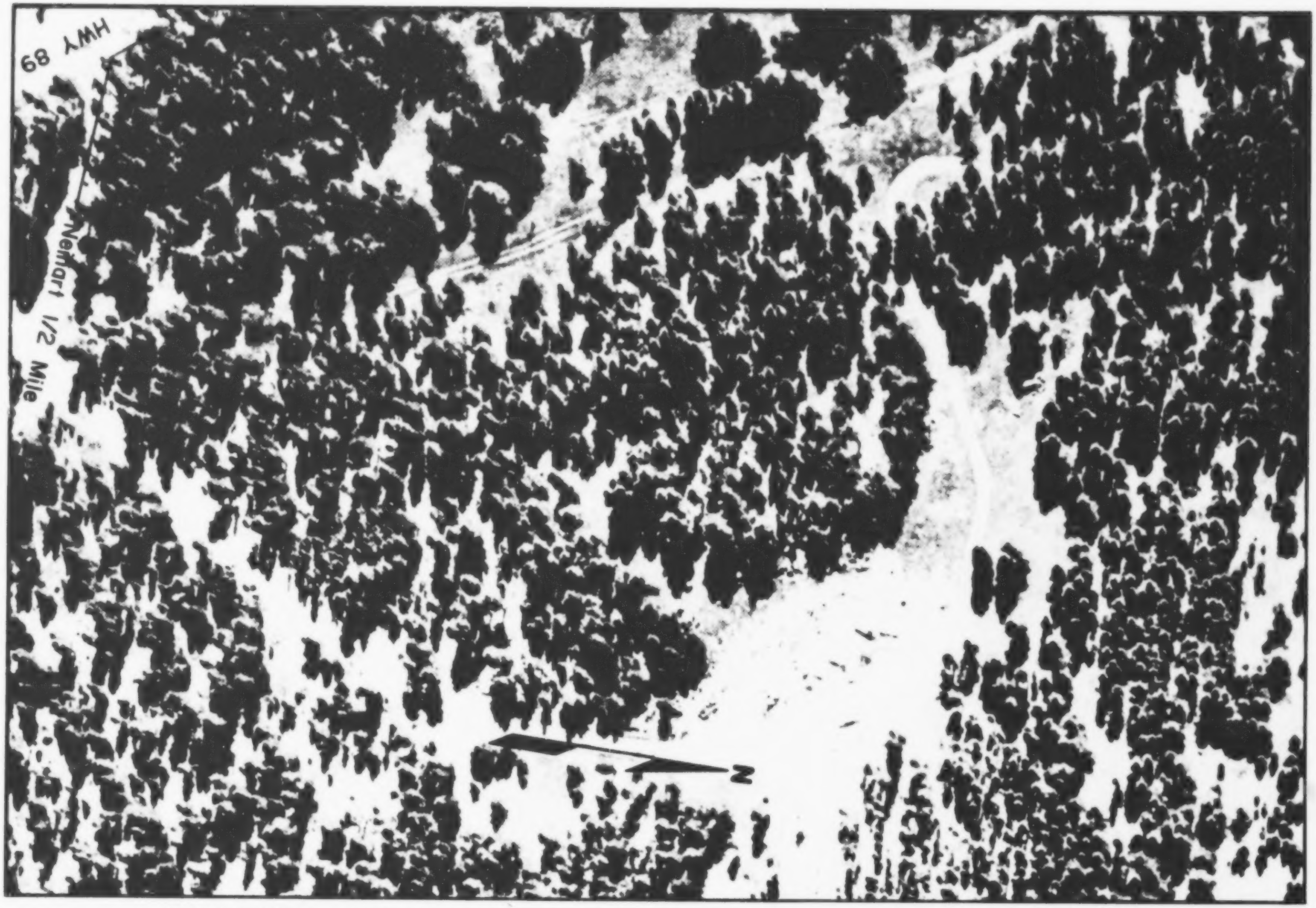
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Neihart 1/2 Mile
N

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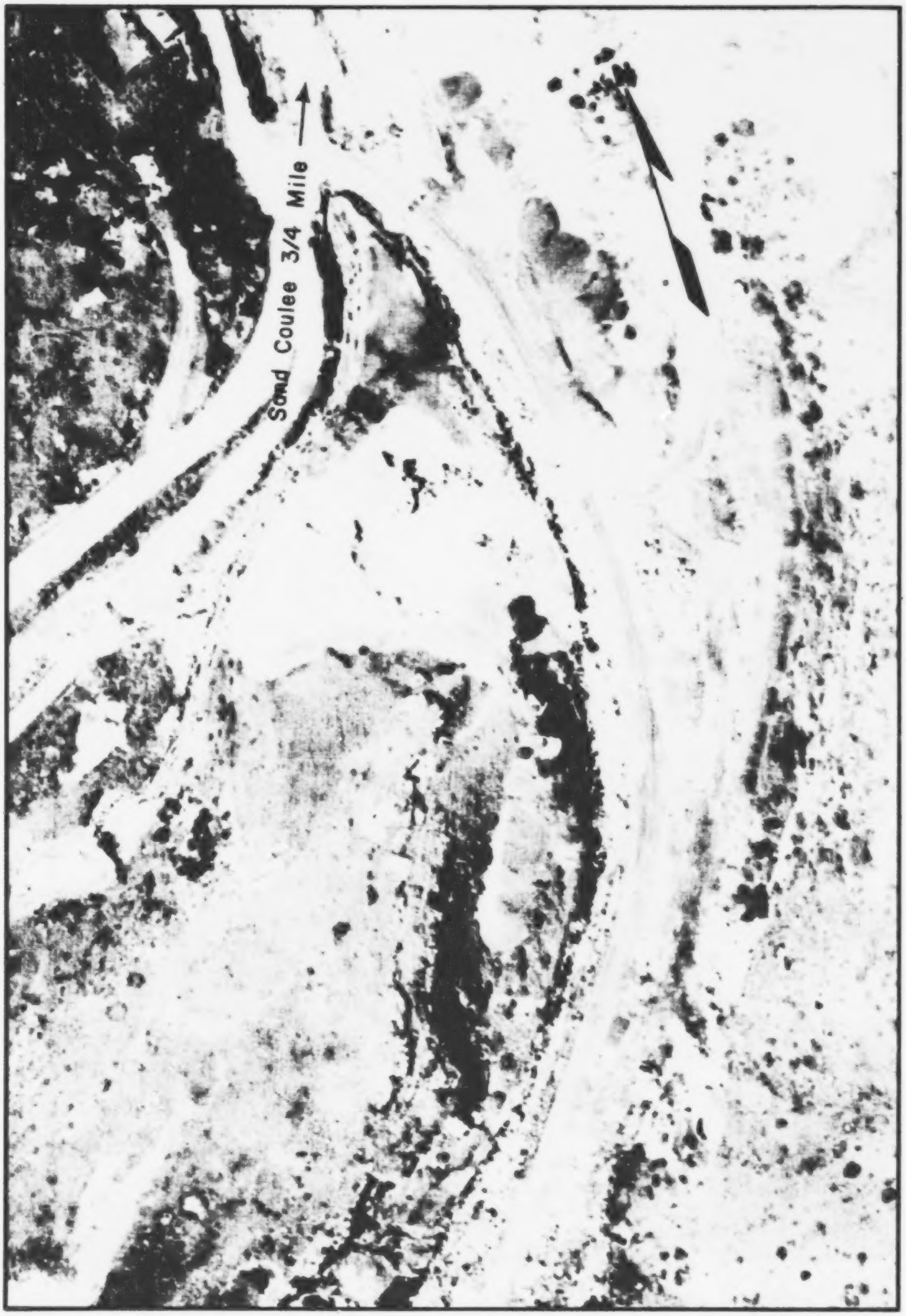
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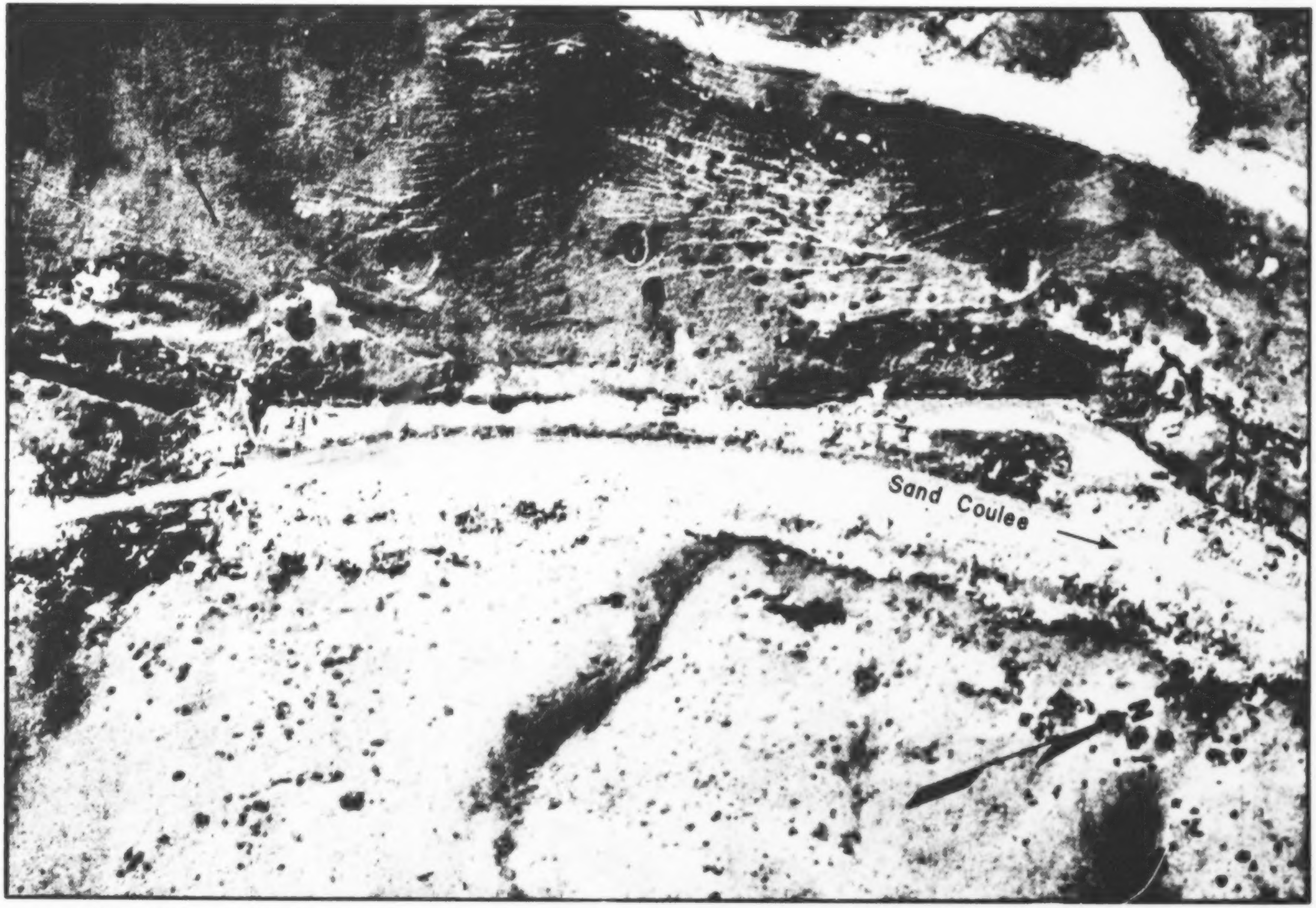
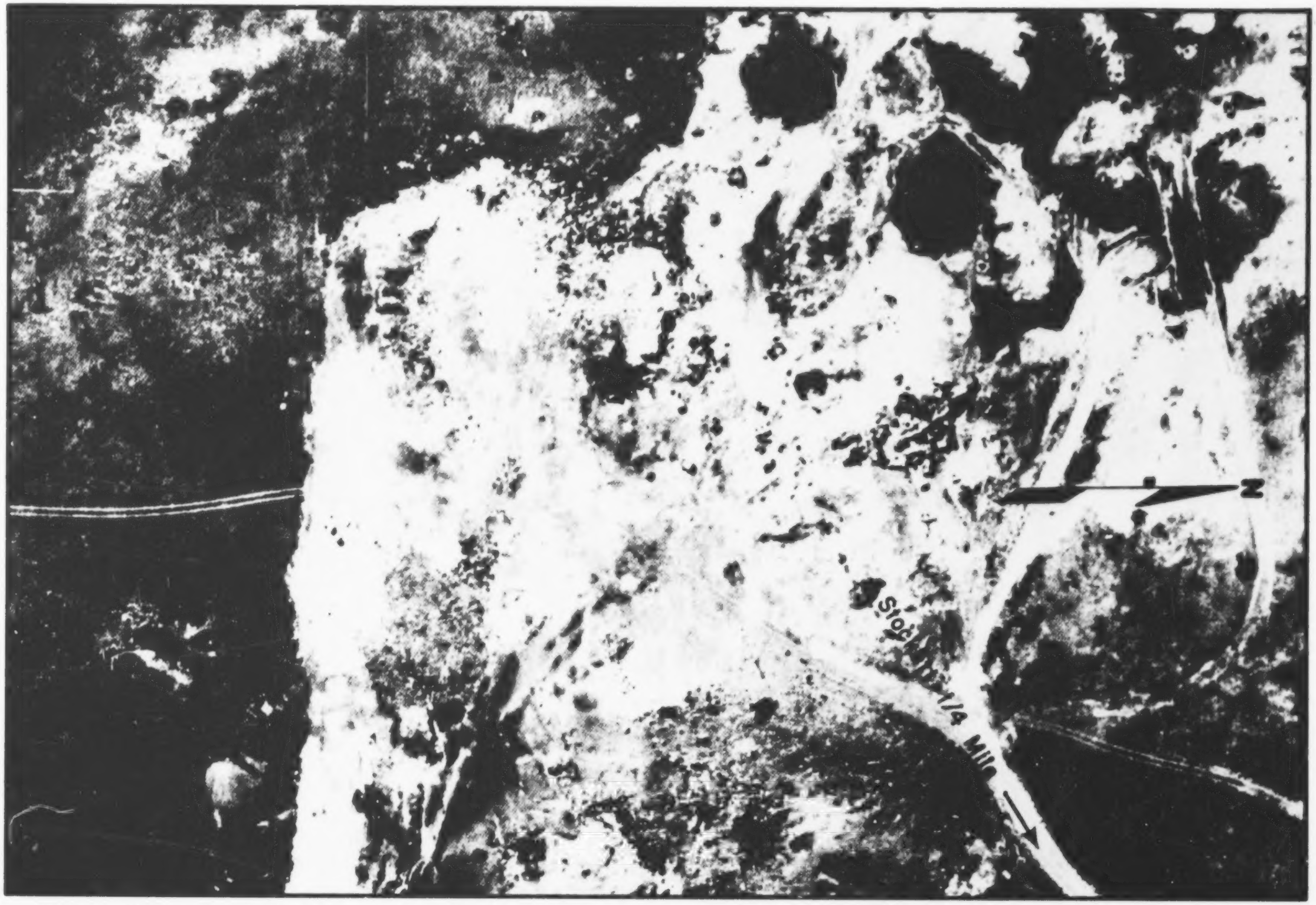

Sand Coulee

EXISTING SAND COULEE & TRACY REFUSE DISPOSAL AREA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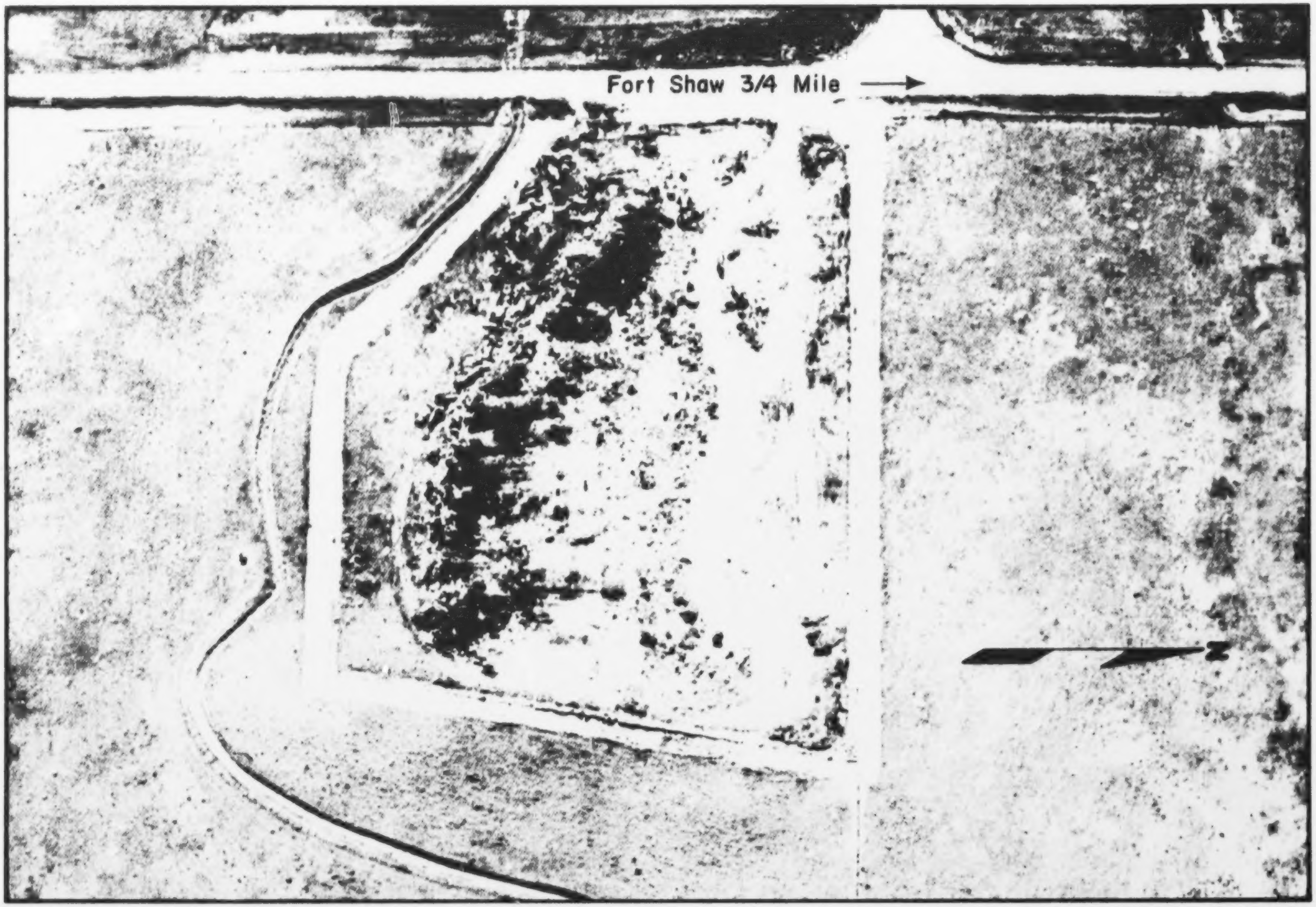
Stock 1/4 Mile

EXISTING STOCKETT & CENTERVILLE REFUSE DISPOSAL AREA Exhibit #6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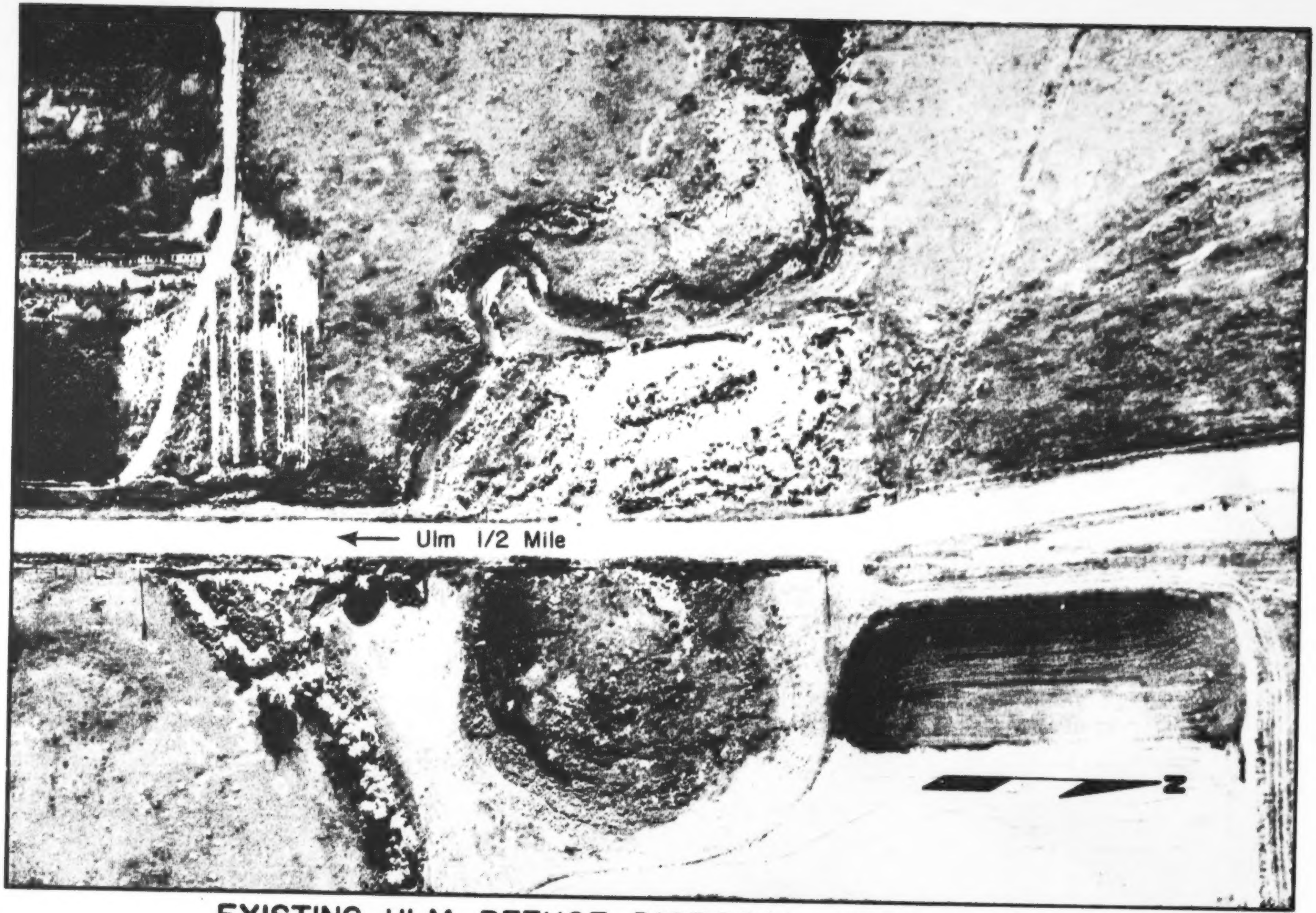
EXISTING SUN RIVER, FORT SHAW & SIMMS REFUSE DISPOSAL AREA Exhibit #7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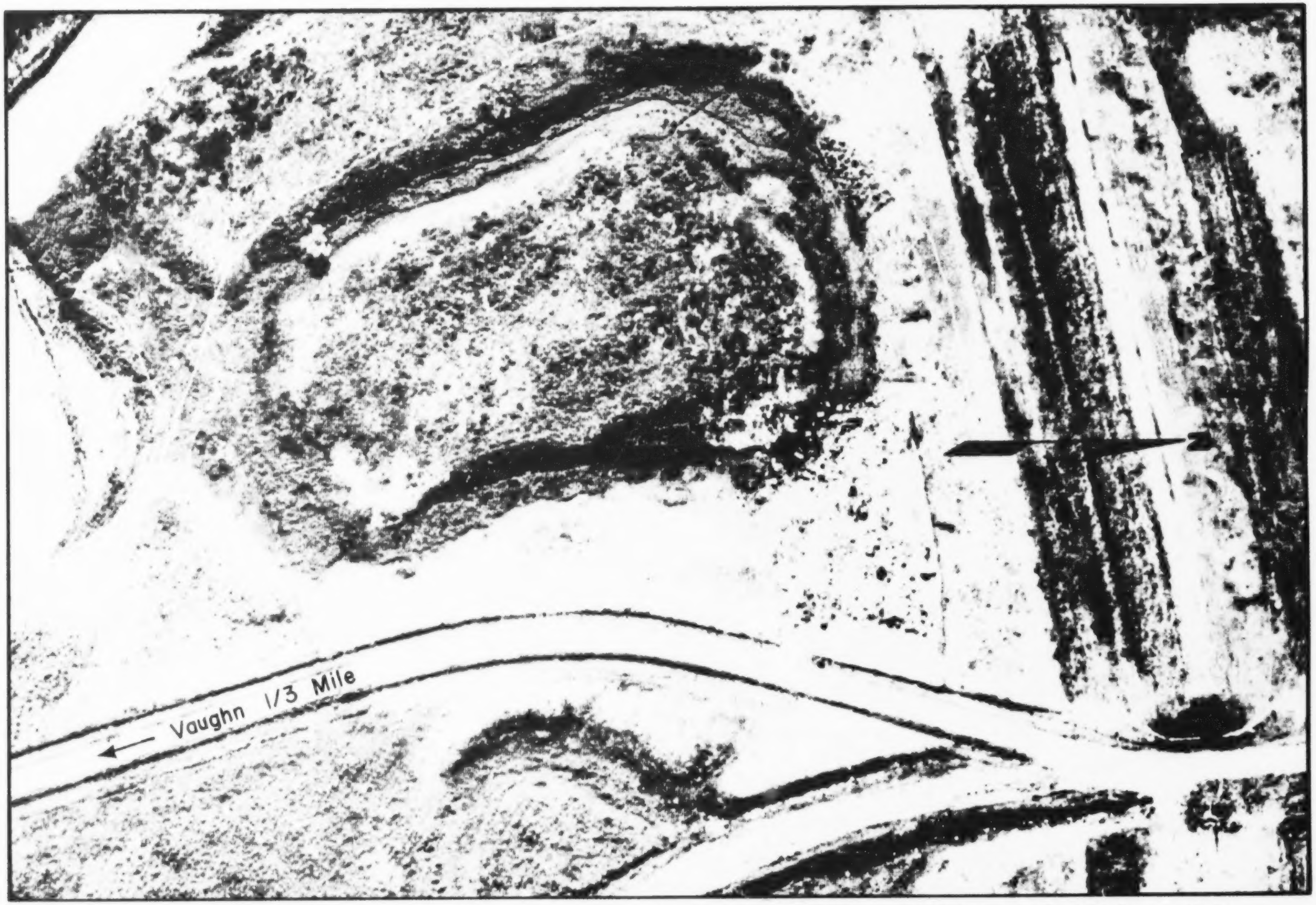
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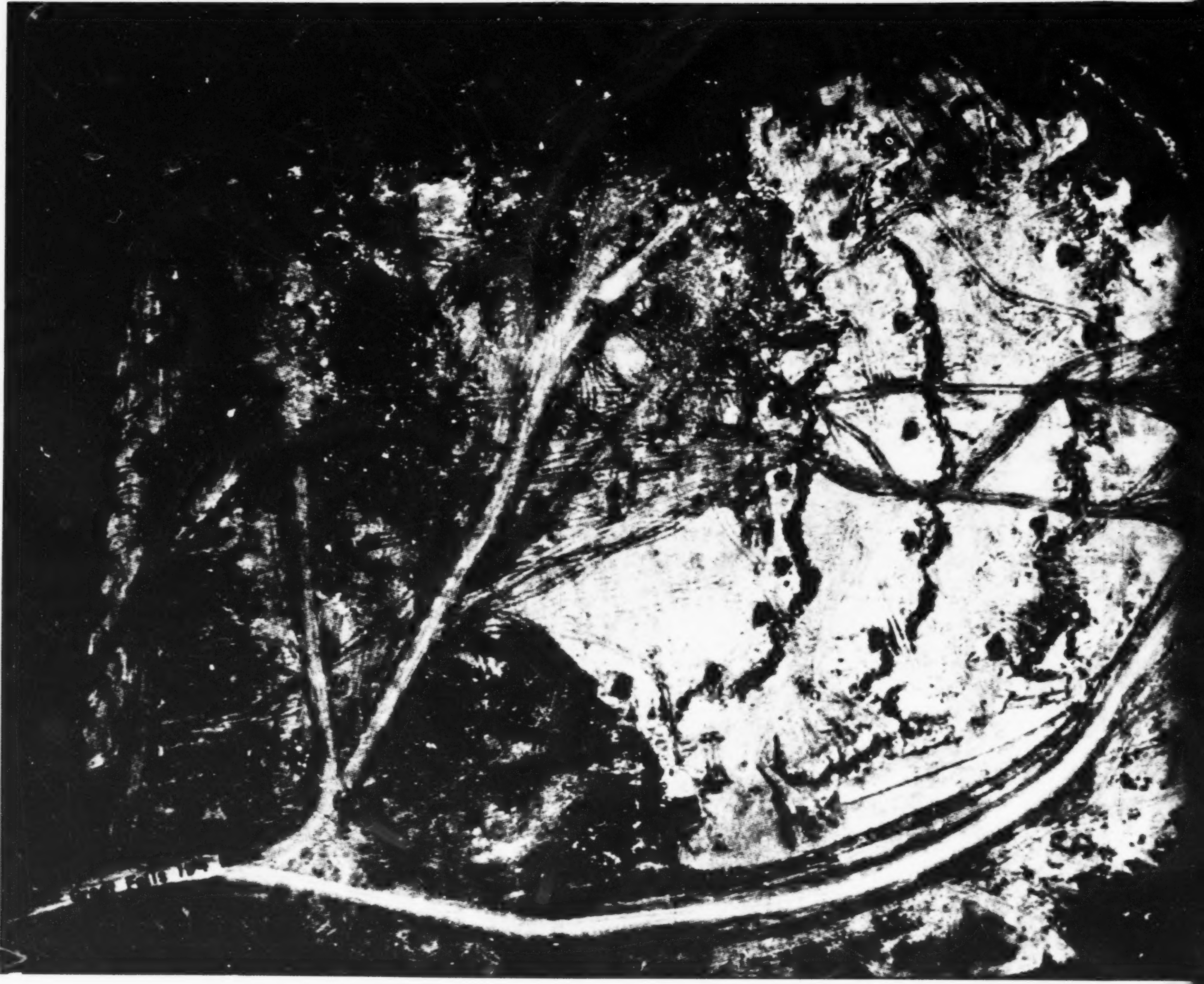

EXISTING GREAT FALLS

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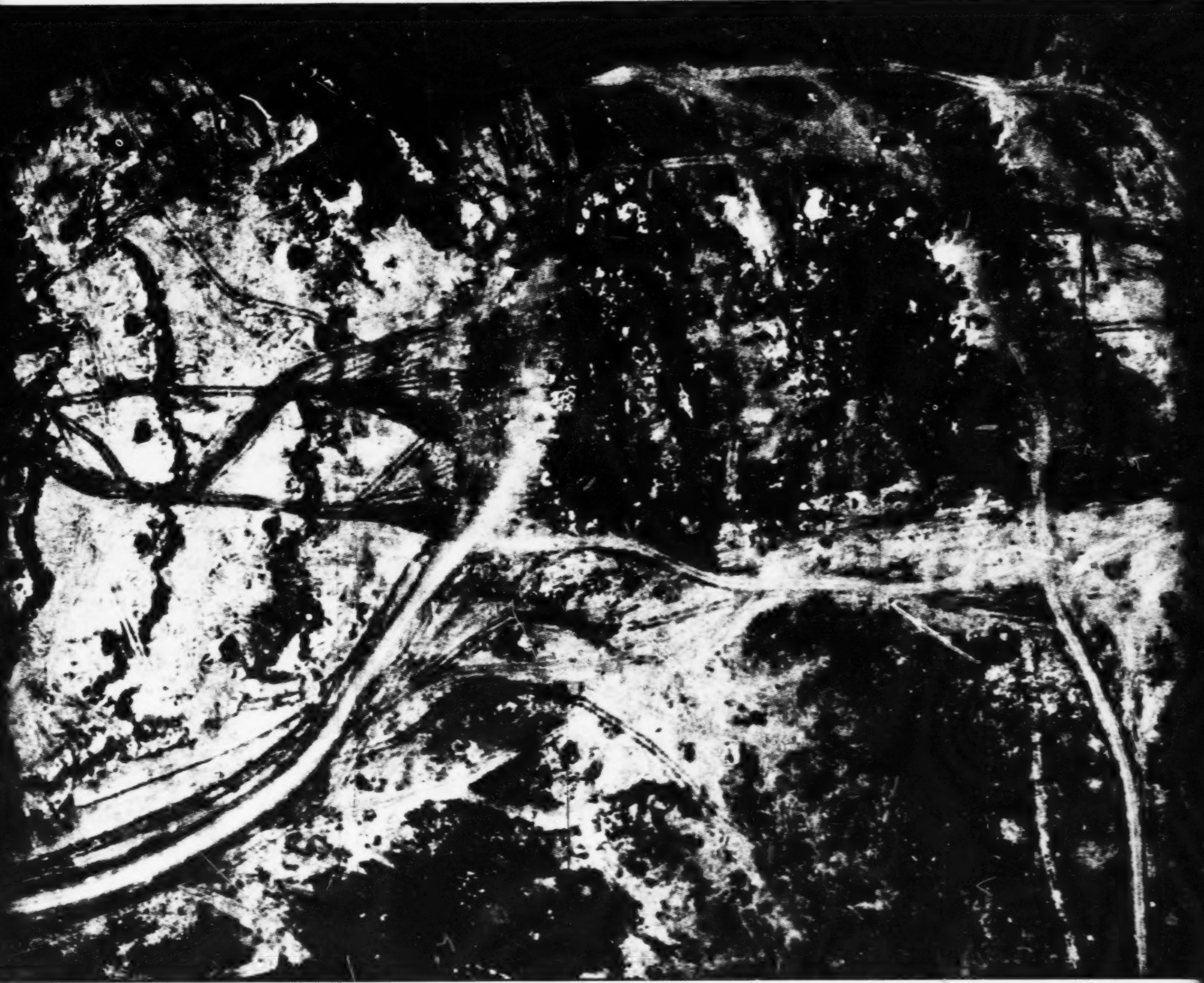

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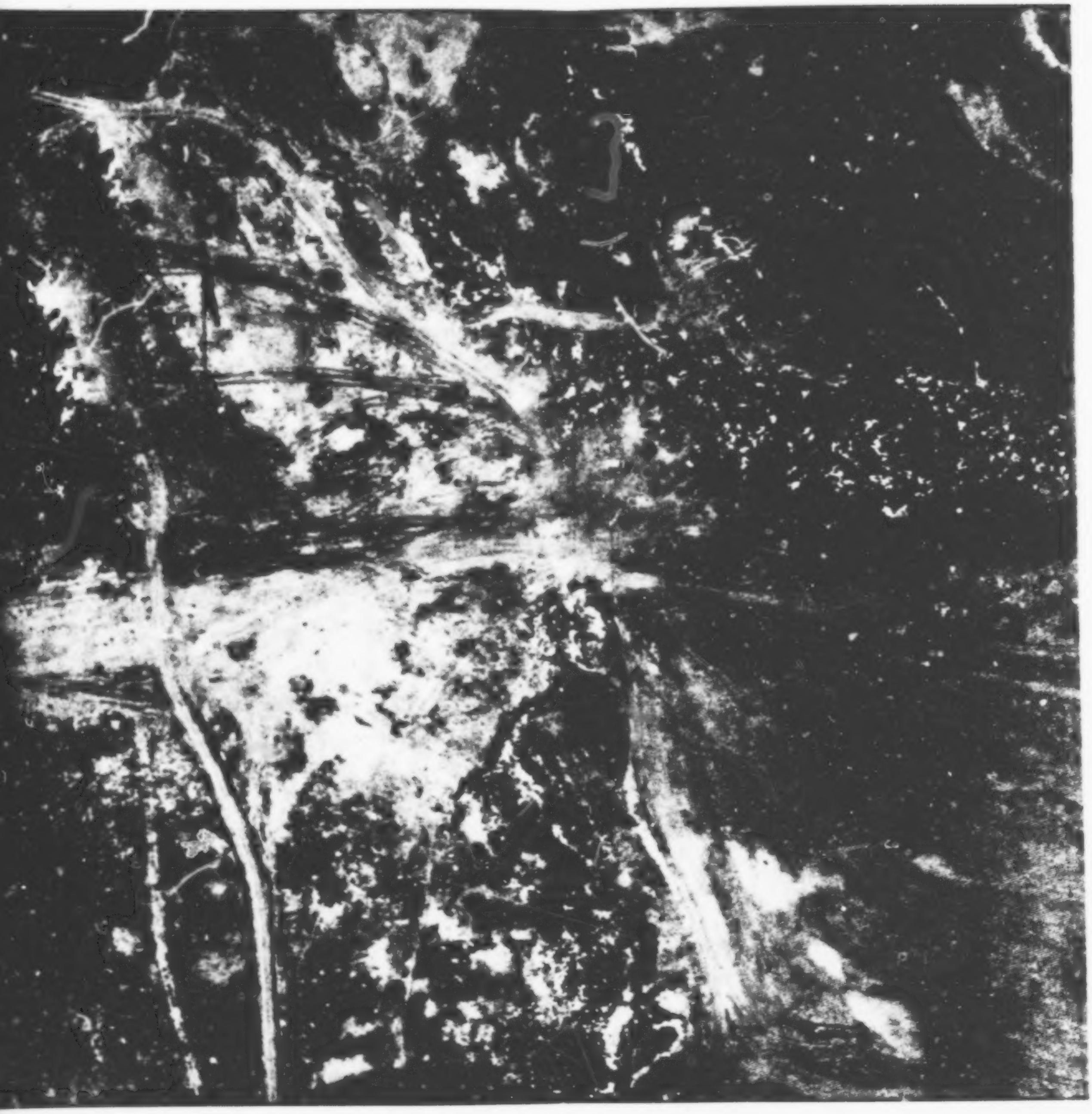

Exhibit #10

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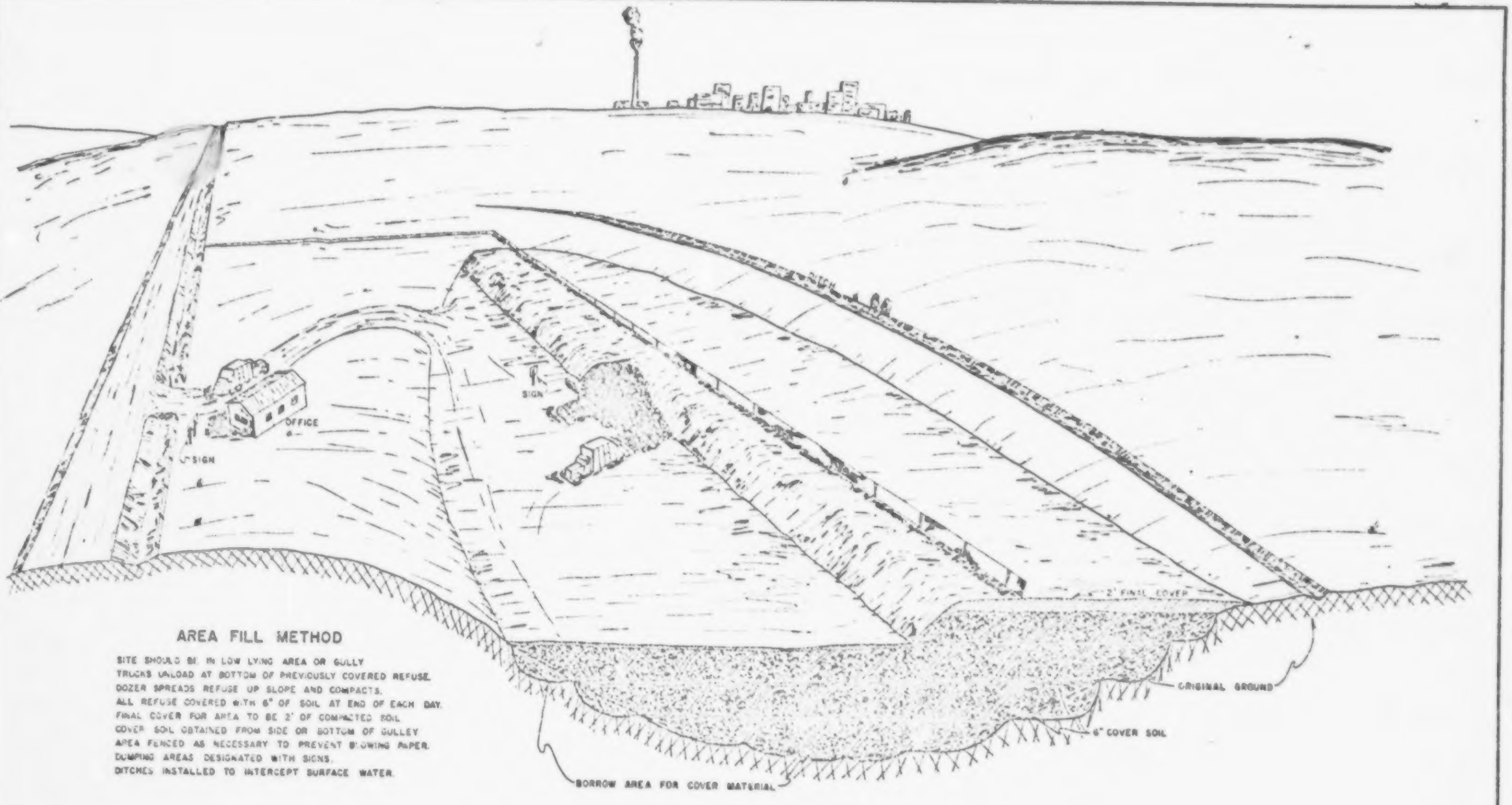
SIGN
OFFICE
SIGN
2' FINAL COVER
ORIGINAL GROUND
6" COVER SOIL
BORROW AREA FOR COVER MATERIAL

AREA FILL METHOD

SITE SHOULD BE IN LOW LYING AREA OR GULLY
TRUCKS UNLOAD AT BOTTOM OF PREVIOUSLY COVERED REFUSE.
DOZER SPREADS REFUSE UP SLOPE AND COMPACTS.
ALL REFUSE COVERED WITH 6" OF SOIL AT END OF EACH DAY.
FINAL COVER FOR AREA TO BE 2' OF COMPACTED SOIL
COVER SOIL OBTAINED FROM SIDE OR BOTTOM OF GULLEY
AREA FENCED AS NECESSARY TO PREVENT BLOWING PAPER.
DUMPING AREAS DESIGNATED WITH SIGNS.
DITCHES INSTALLED TO INTERCEPT SURFACE WATER.

REVISIONS	DATE Aug. 1968 DRAWN RAL DESIGNED [illegible] APPROVED WWD JOB NO. 504-67	THOMAS, DEAN & HOSKINS INC. ENGINEERING CONSULTANTS GREAT FALLS, MONTANA	SOLID WASTES DISPOSAL CASCADE COUNTY, MONTANA	SANITARY LANDFILL AREA METHOD	Exhibit #11

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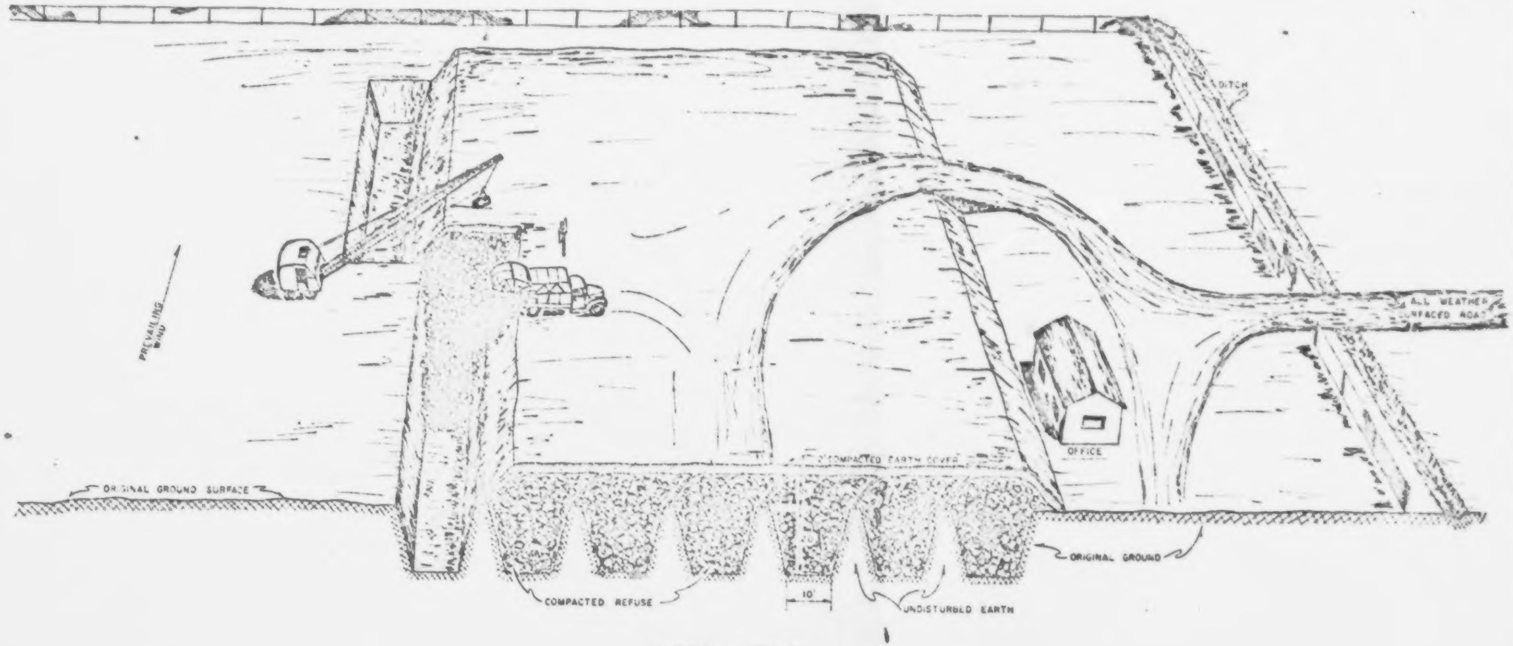
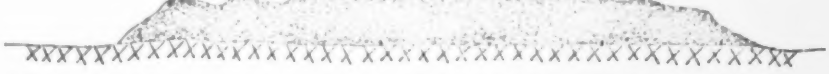

DITCH
ALL WEATHER SURFACED ROAD
PREVAILING WIND
OFFICE
2' COMPACTED EARTH COVER
ORIGINAL GROUND SURFACE
ORIGINAL GROUND
COMPACTED REFUSE
10'
UNDISTURBED EARTH

TRENCH METHOD

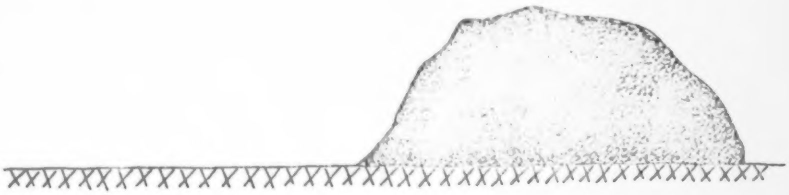
TERRAIN SHOULD BE FLAT OR GENTLY SLOPING
TRUCKS UNLOAD ABOVE TRENCH
COMPACTION OBTAINED BY EQUIPMENT AND TRUCK TRAVEL.
ALL REFUSE COVERED WITH 6" OF SOIL AT END OF EACH DAY
FINAL COVER FOR AREA TO BE 2' OF COMPACTED SOIL.
COVER OBTAINED BY FURTHER EXCAVATION IN SAME TRENCH OR ALTERNATE TRENCH.
AREA FENCED AS NECESSARY TO PREVENT BLOWING PAPER
DUMPING AREAS DESIGNATED WITH SIGNS.
DITCHES INSTALLED TO INTERCEPT SURFACE WATER.

REVISIONS	DATE Aug 1968 SCALE None	DRAWN RAL DESIGNED LDH APPROVED WWD	JOB NO. 504-67	THOMAS, DEAN & HOSKINS INC. ENGINEERING CONSULTANTS GREAT FALLS, MONTANA	SOLID WASTES DISPOSAL CASCADE COUNTY, MONTANA	SANITARY LANDFILL TRENCH METHOD	Exhibit # 12

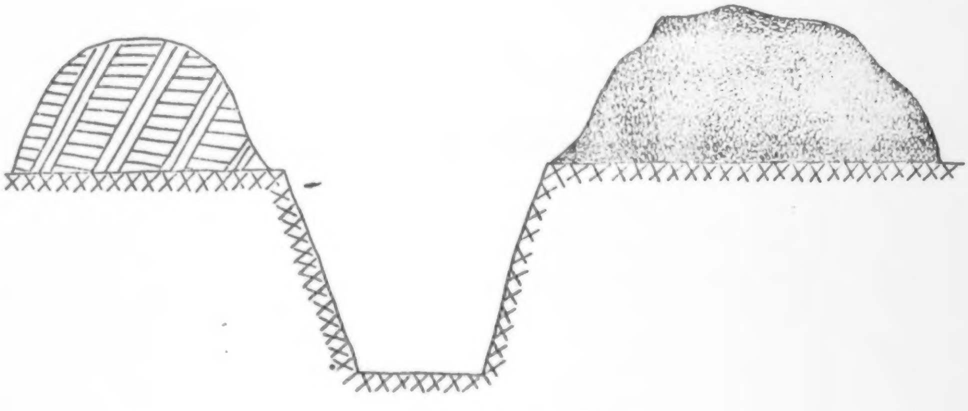
AREA CLEANUP OF OPEN DUMP



LOOSE SCATTERED REFUSE



REFUSE PUSHED BACK



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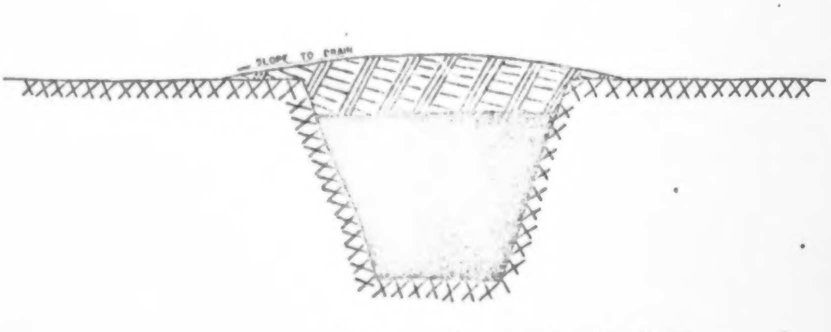

REFUSE COMPACTED IN TRENCH AND COVERED

REVISIONS

Aug 1968

RAL
LDH
WHD

524-67

THOMAS, DEAN & HOSKINS INC
ENGINEERING CONSULTANTS
GREAT FALLS, MONTANA

SOLID WASTES DISPOSAL
CASCADE COUNTY, MONTANA

AREA CLEANUP OF
OPEN DUMP

Exhibit
#13

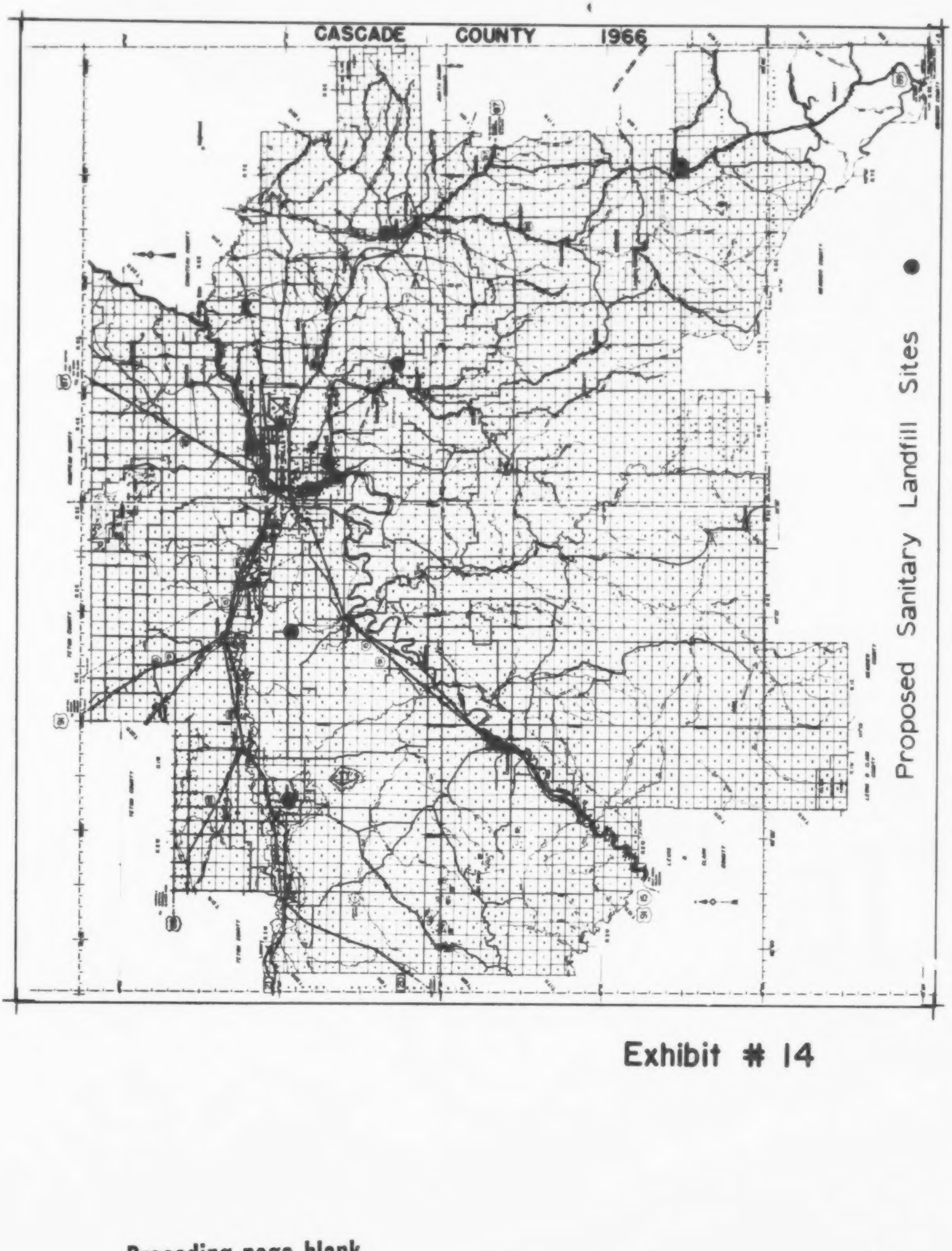
CASCADE COUNTY 1966
Proposed Sanitary Landfill Sites ●

Exhibit # 14

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BELT

Township Number 19 N. Range Number 6 E.

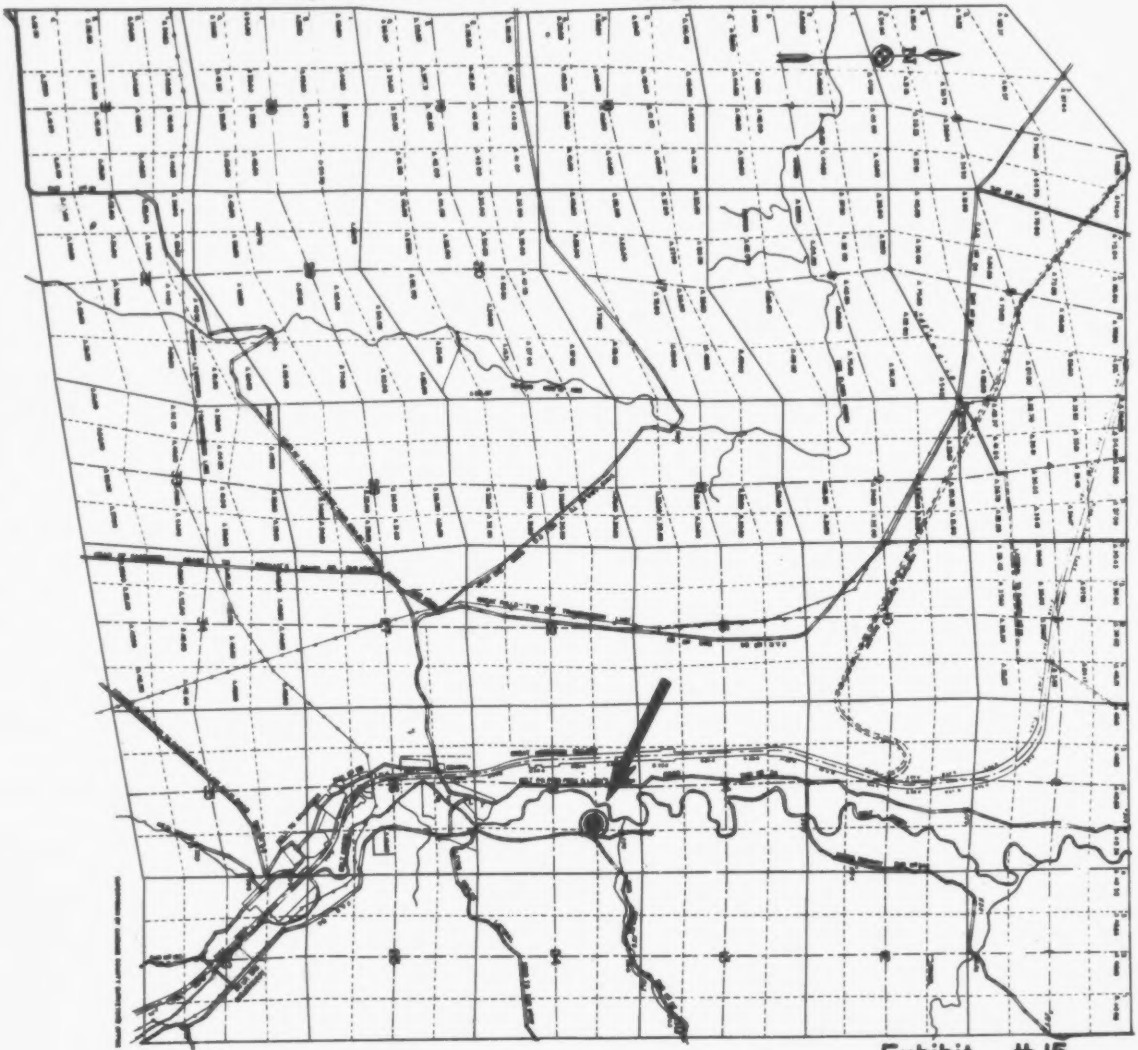


Exhibit # 15

CASCADE

Township Number 18 N. Range Number 1 W.

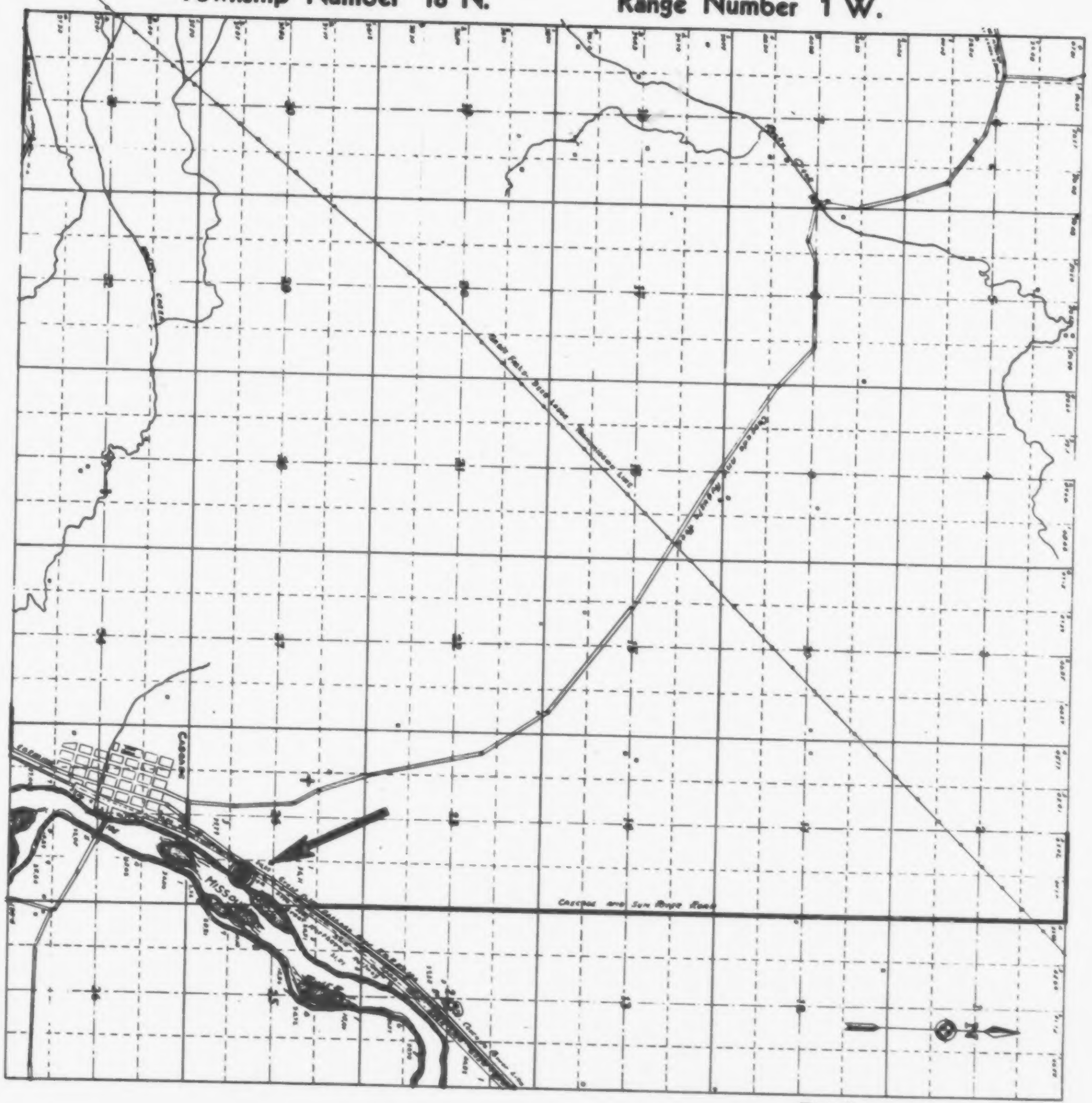

Cascade
Cascade and Sun River Road

Exhibit #16

FORT SHAW, SIMMS & SUN RIVER

Township Number 20 N. Range Number 1 W.

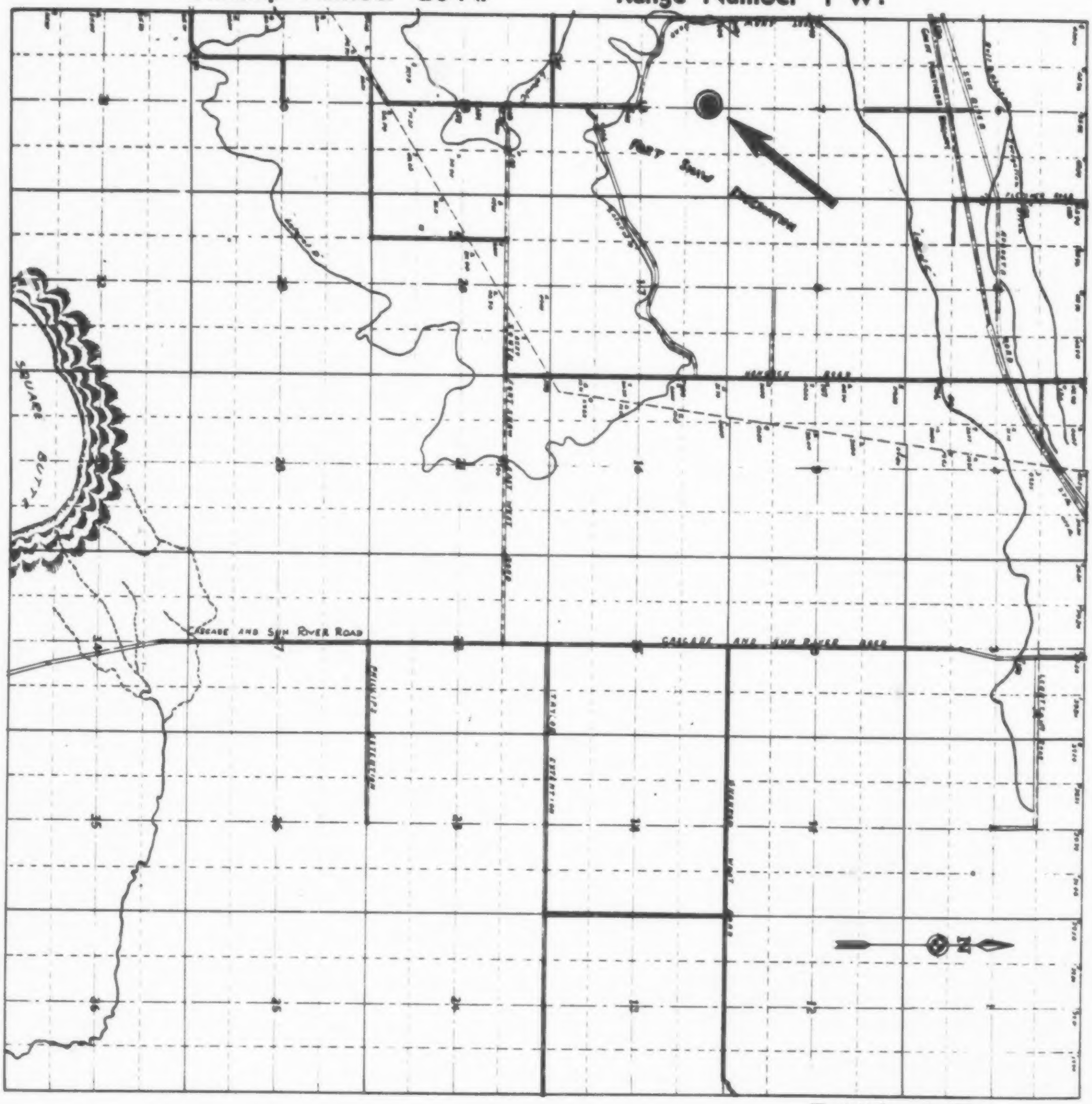

Fort Shaw Reservation
Square Butte
Cascade and Sun River Road
Cascade and Sun River Road
N

Exhibit #17

GREAT FALLS NORTH

Township Number 21 N. Range Number 4 E.

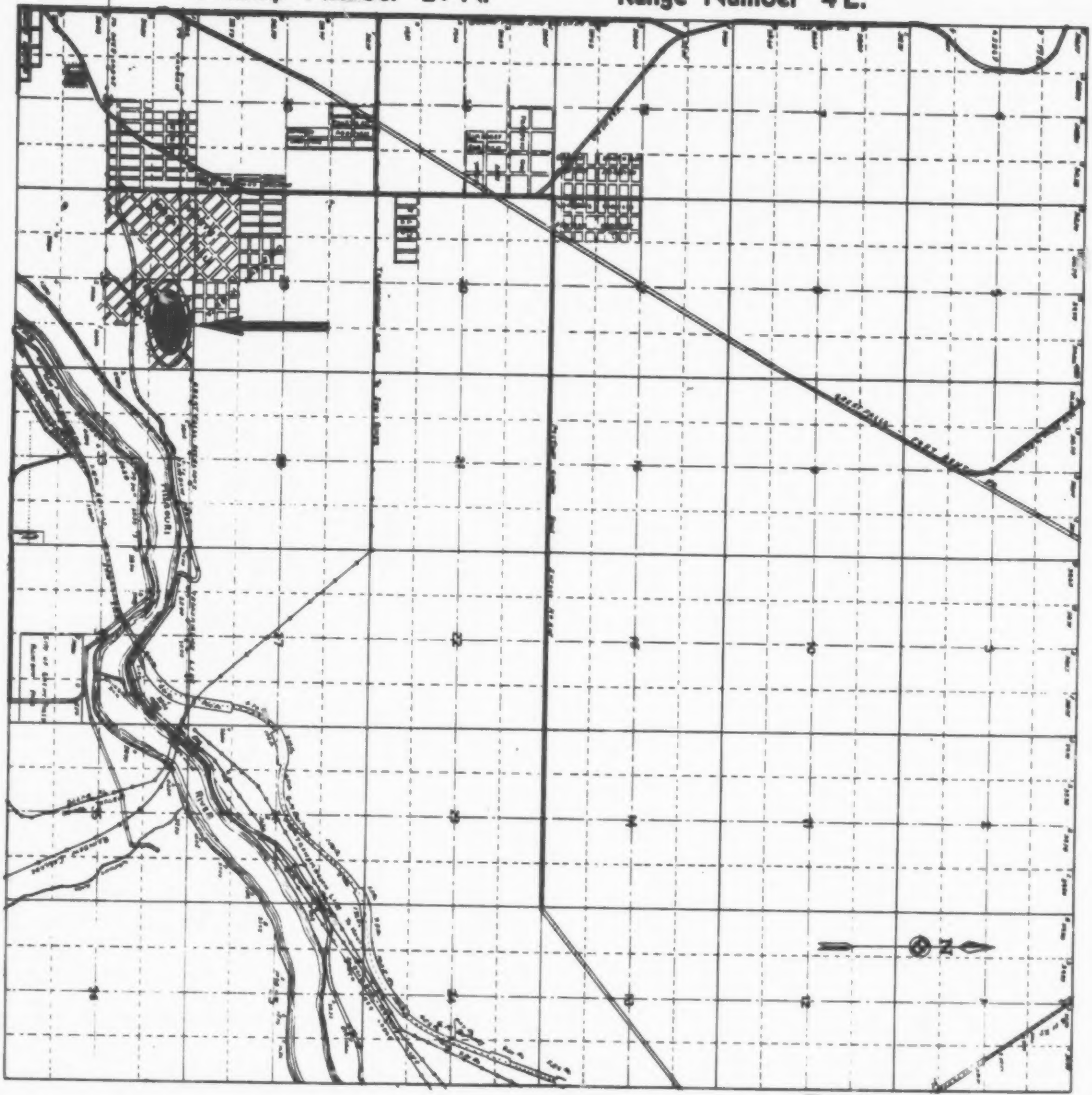


Exhibit #18

GREAT FALLS SOUTH

Township Number 20 N. Range Number 4 E.

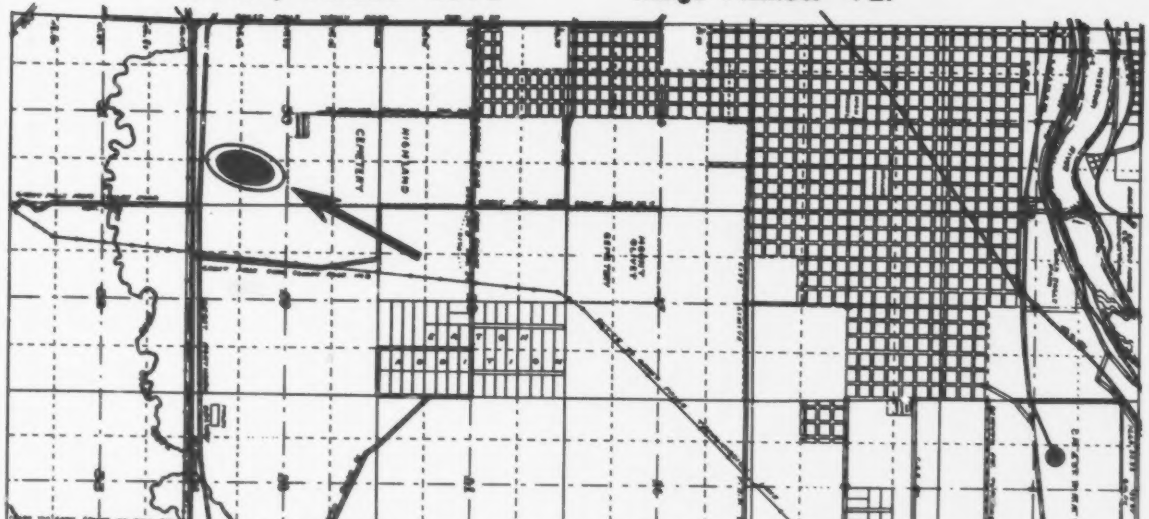

CEMETERY
HIGHLAND
EAST AIR BASE
N

Exhibit #19

MONARCH - NEIHART

Township Number 15 N. Range Number 7 E.

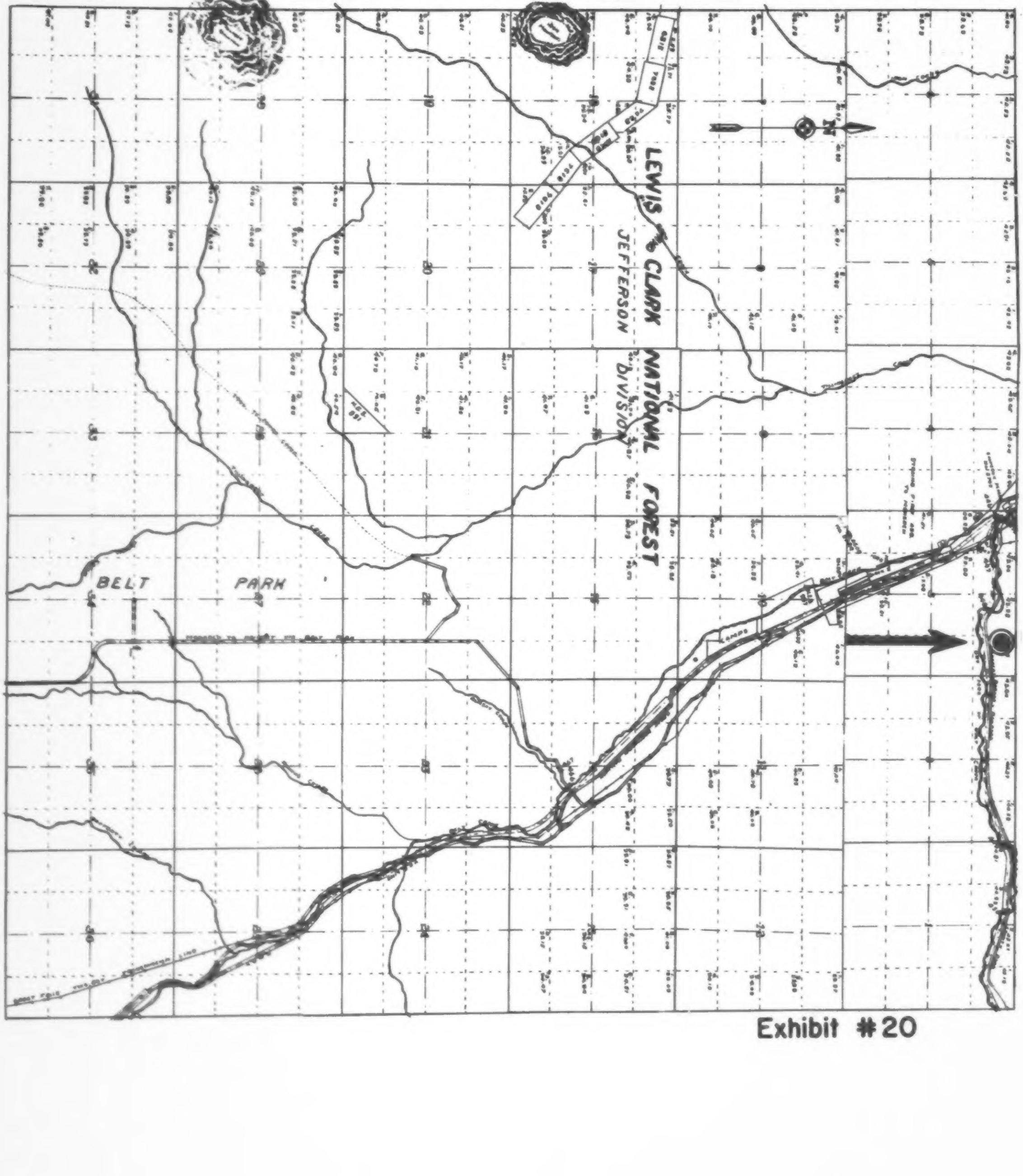

N
LEWIS & CLARK NATIONAL FOREST
JEFFERSON DIVISION
BELT PARK

Exhibit #20

SAND COULEE, TRACY
STOCKETT & CENTERVILLE

Township Number 19 N. Range Number 5 E.

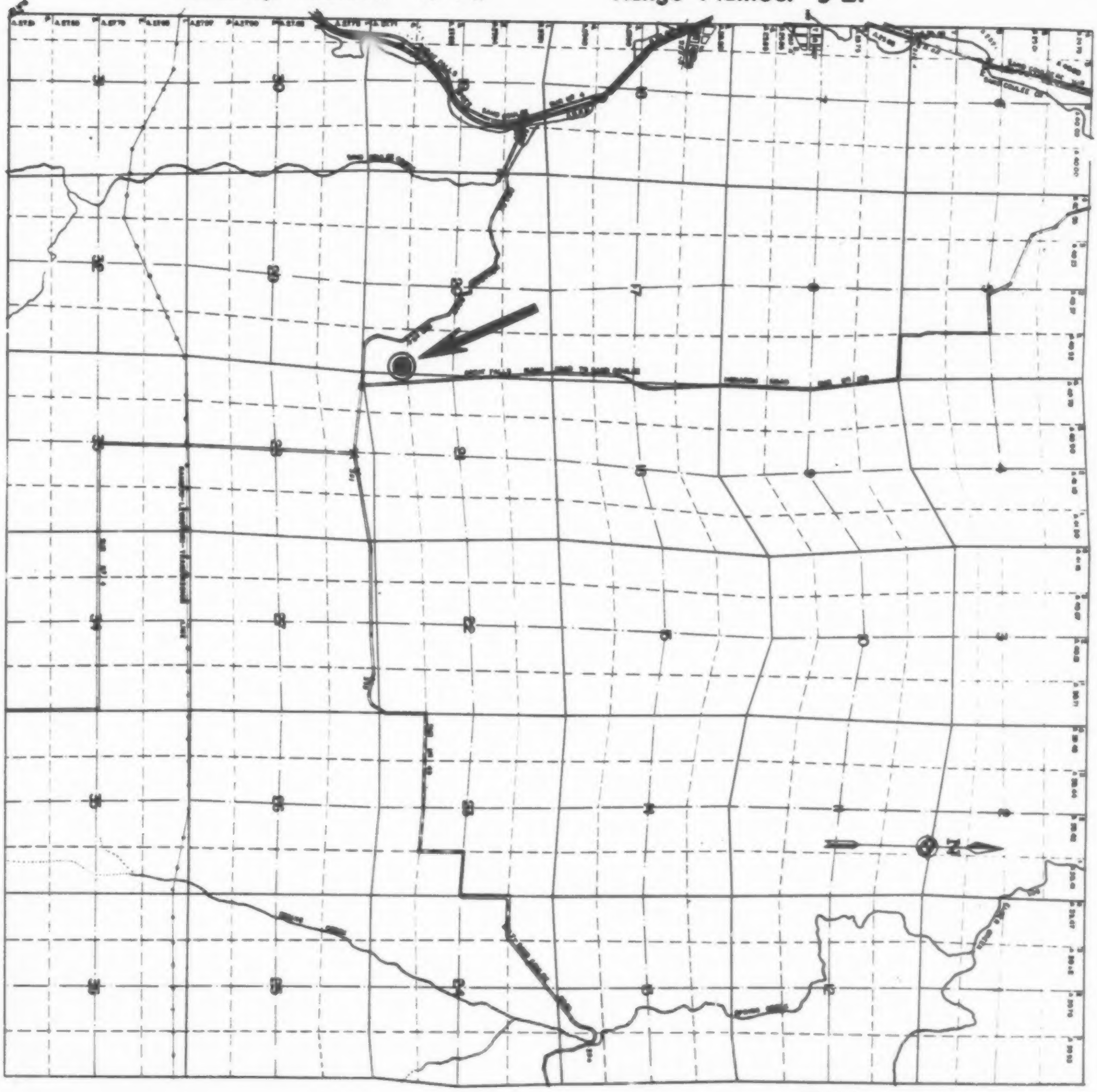


Exhibit #21

ULM - VAUGHN

Township Number 20 N. Range Number 2 E:

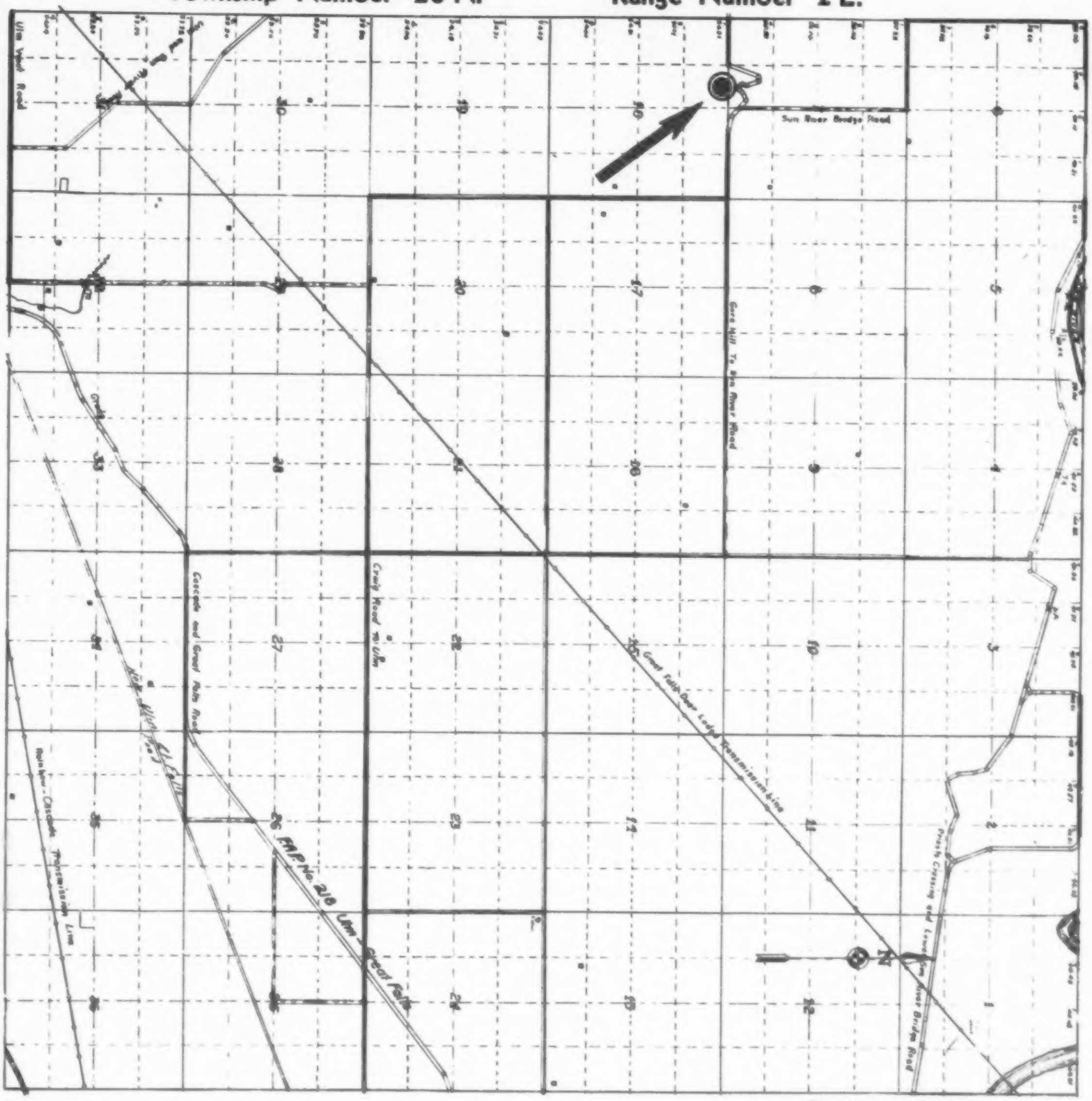
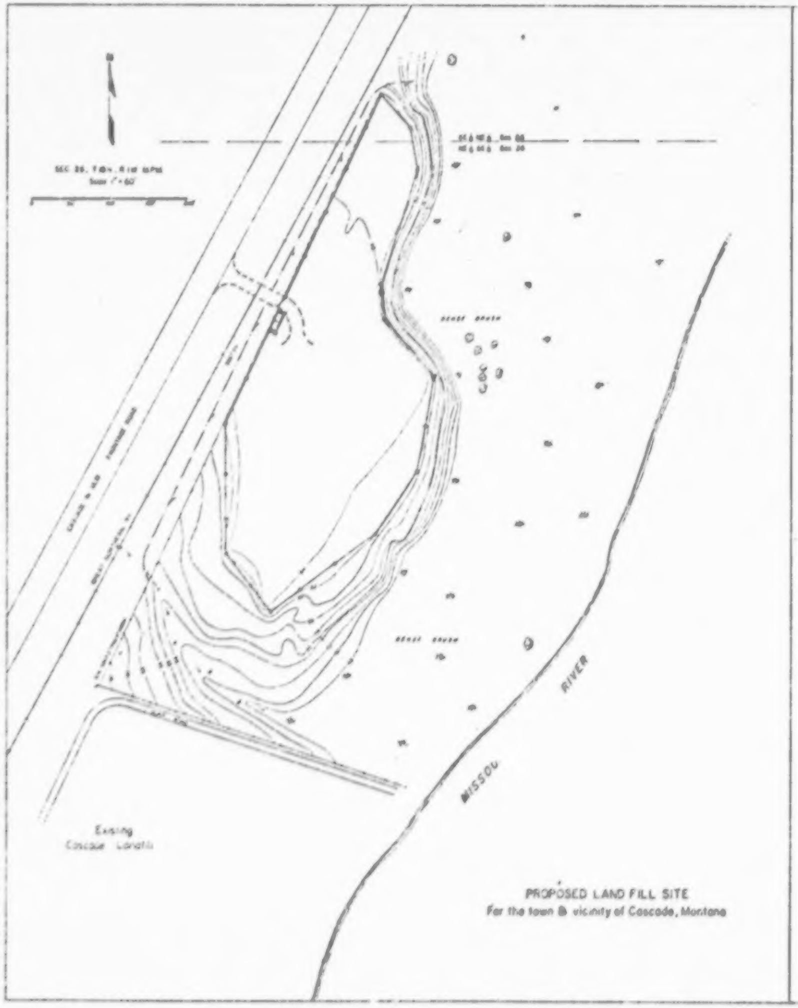
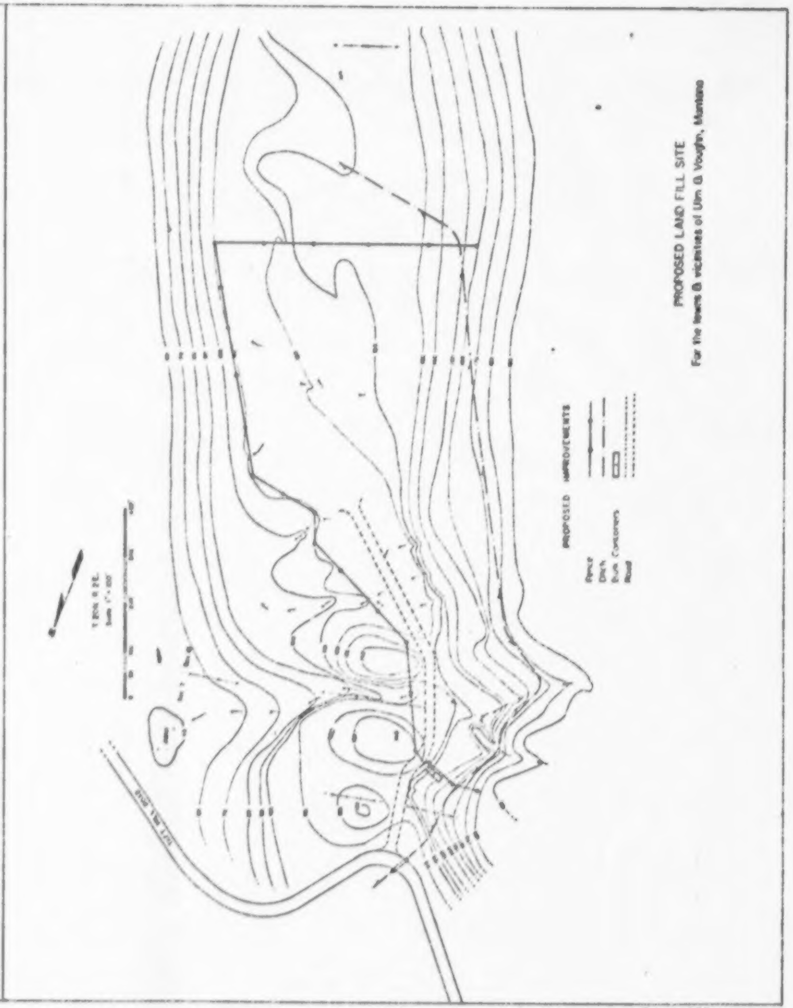

Ulm Vaughn Road
Sun River Bridge Road
Gore Hill To Sun River Road
Cascade and Great Falls Road
Craig Road to Ulm
Great Falls Deer Lodge Transmission Line
FAP No. 218 Ulm - Great Falls
Rainbow - Cascade Transmission Line
River Bridge Road

Exhibit #22

☆ U. S. GOVERNMENT PRINTING OFFICE : 1970 O - 382-960


DENSE BRUSH
DENSE BRUSH
MISSOU
RIVER
Existing
Cascade Landfill

PROPOSED LAND FILL SITE
For the town & vicinity of Cascade, Montana


PROPOSED IMPROVEMENTS
Fence
Ditch
Bulk Containers
Road

PROPOSED LAND FILL SITE
For the towns & vicinities of Ulm & Vaughn, Montana

Exhibit #25

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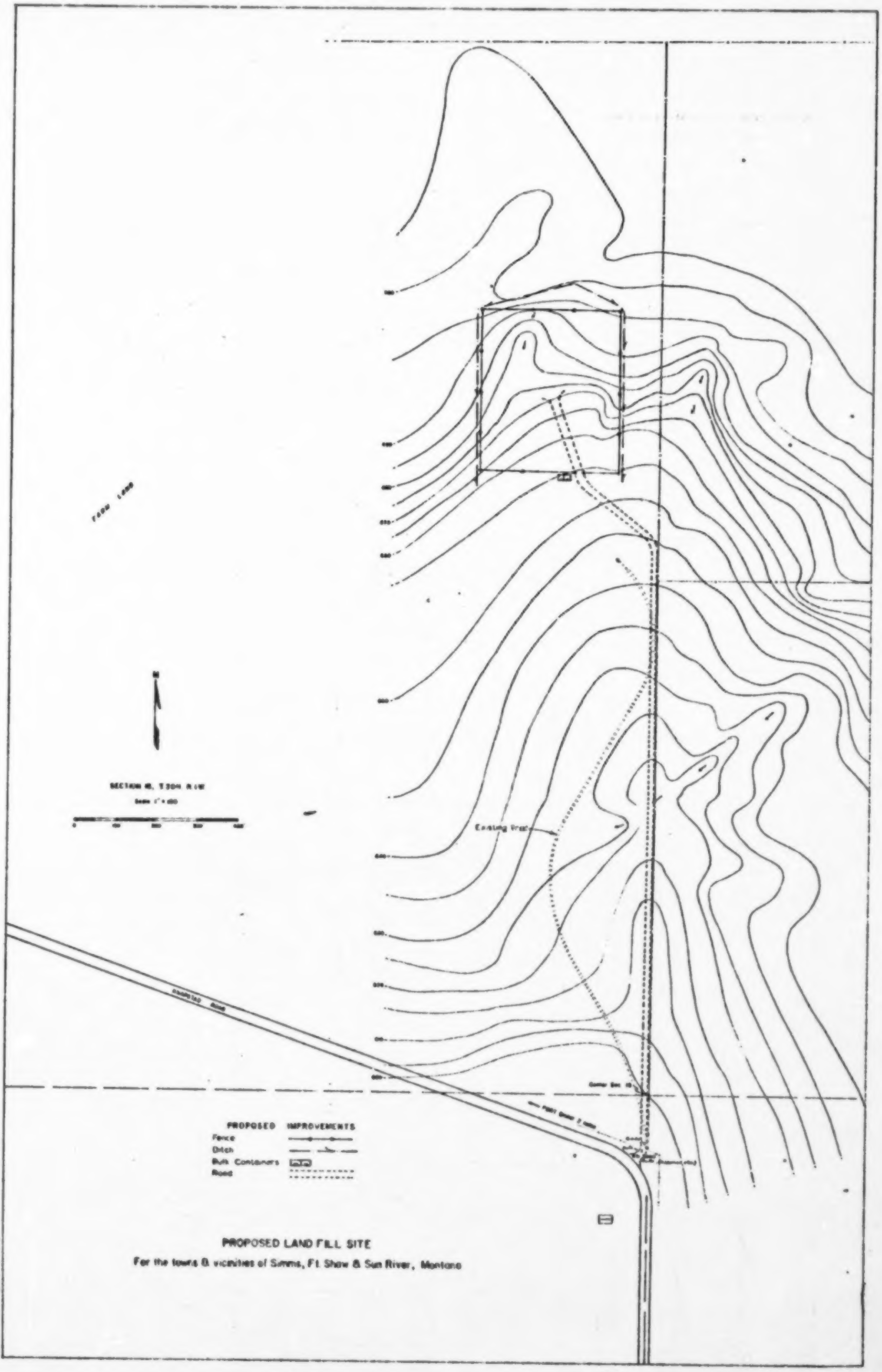
Existing Trail
Farm Land
Center Sec. 10
PROPOSED IMPROVEMENTS
Fence
Ditch
Bulk Containers
Road
SECTION 10, T 20N R 1W
Scale 1" = 400
0

PROPOSED LAND FILL SITE

For the towns & vicinities of Simms, Ft. Shaw & Sun River, Montana

Exhibit #23

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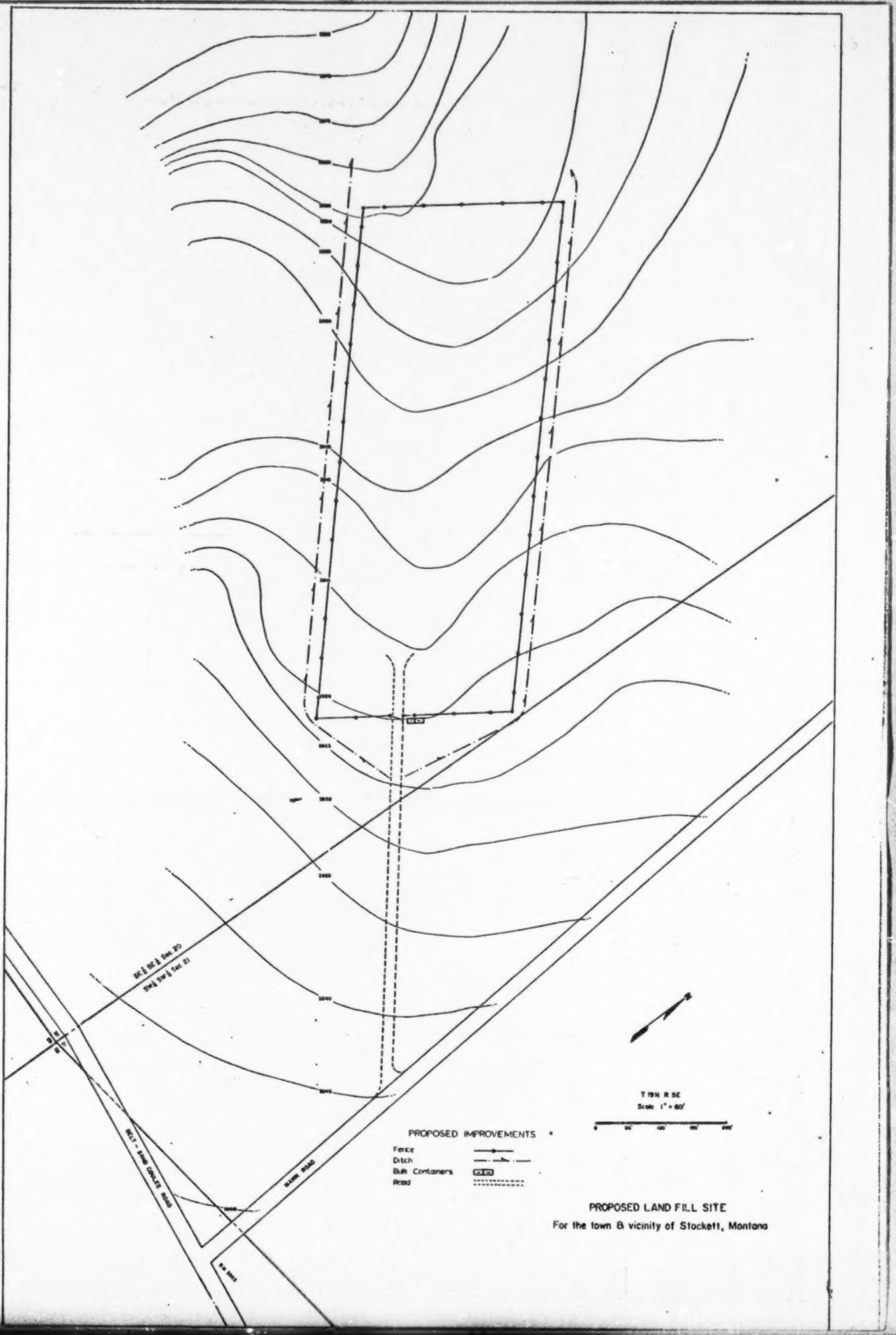
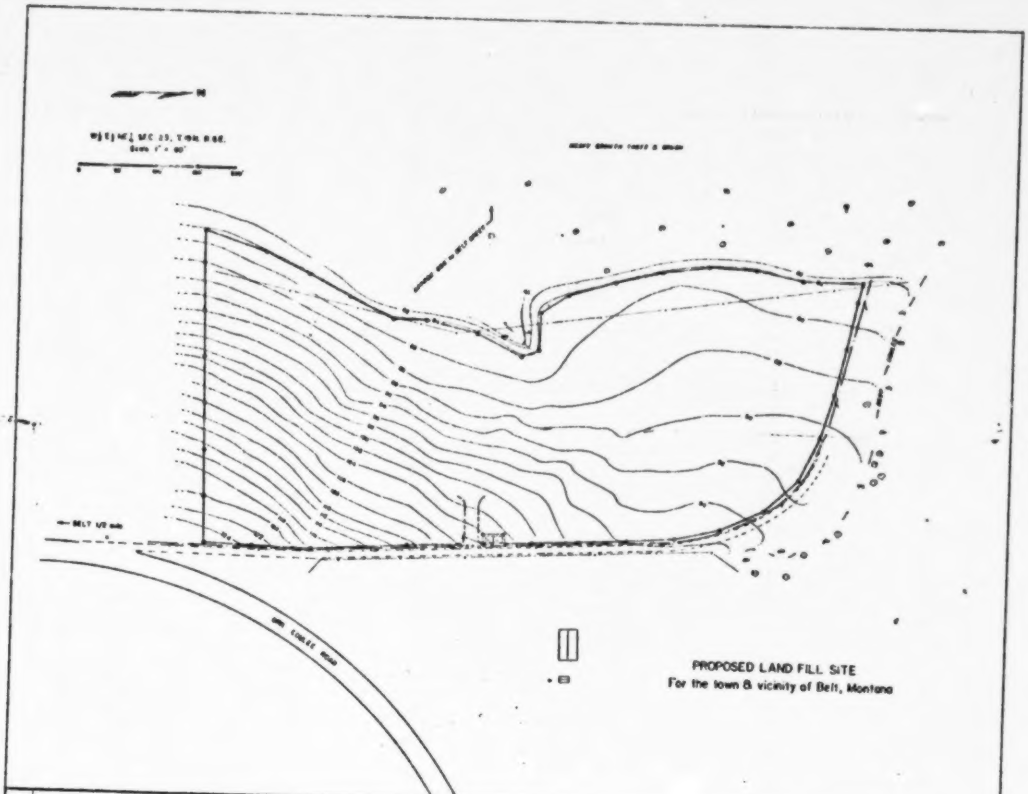

SE ¼ SE ¼ Sec 20
SW ¼ SW ¼ Sec 21
BELT - SAND COULEE ROAD
MAIN ROAD
T 19N R 5E
Scale 1" = 60'
PROPOSED IMPROVEMENTS
Fence
Ditch
Bulk Containers
Road

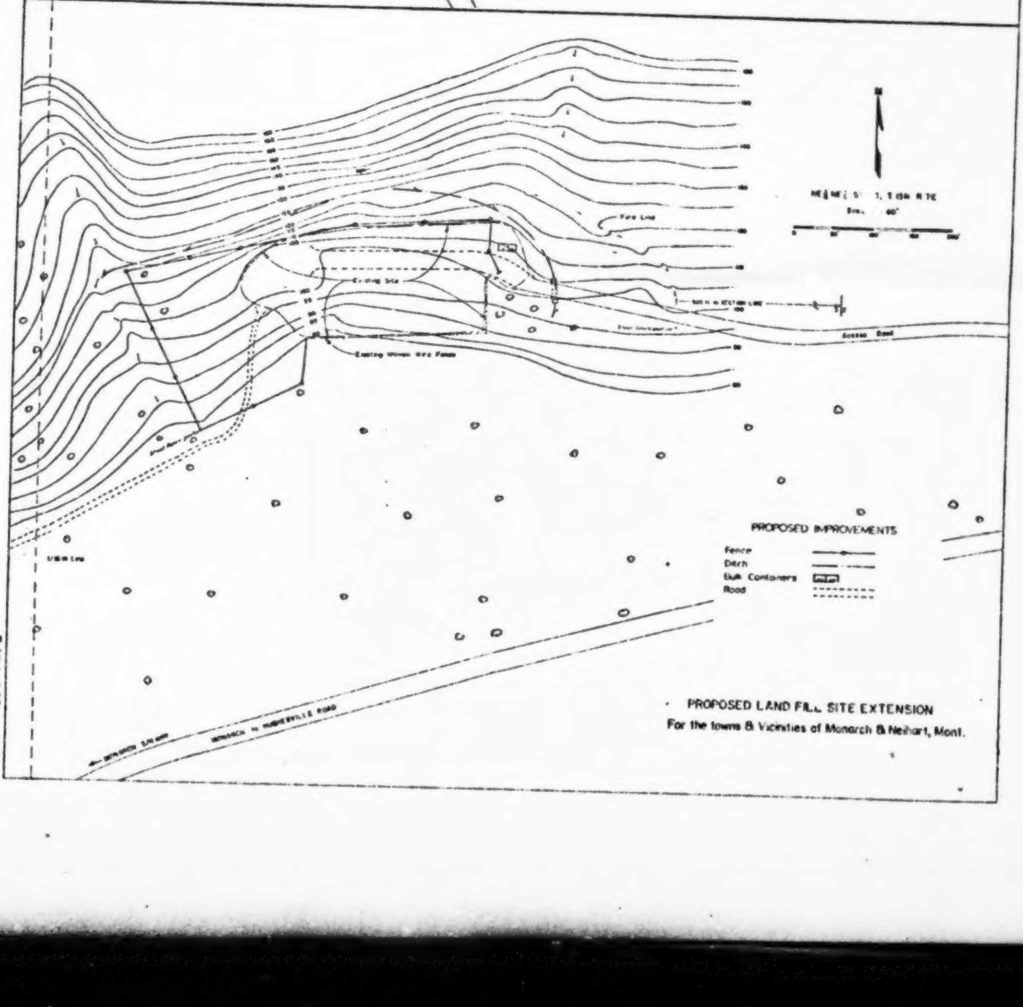
PROPOSED LAND FILL SITE

For the town & vicinity of Stockett, Montana

Exhibit #24


N
Scale 1" = 80'
BELT 1/2 mile
SAND COULEE ROAD

PROPOSED LAND FILL SITE
For the town & vicinity of Belt, Montana


N
Fire Line
Existing Site
Existing Woven Wire Fence
Access Road
PROPOSED IMPROVEMENTS
Fence
Ditch
Bulk Containers
Road

PROPOSED LAND FILL SITE EXTENSION
For the towns & Vicinities of Monarch & Neihart, Mont.

Exhibit #26 188